CAL CHECK ON
PAGE 4-4
SECTION 5

Return To Dept. 814
Test Construction

INSTRUCTION MANUAL

FREQUENCY SELECTIVE VOLTMETER

MODEL 128A

PHILCO

Ford

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FREQUENCY SELECTIVE VOLTMETER
MODEL 128A

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ADDENDUM

MODEL 128A-PA BALANCED PROBE

MODEL 128-MA EXPANDED SCALE METER

UNIVERSAL SPEAKER KIT

MODEL 220A-1 EQUIPMENT CONSOLE

Figure 1-1. Model 128A Frequency Selective Voltmeter

SECTION I
GENERAL

A. PURPOSE

The Model 128A Frequency Selective Voltmeter is designed to measure a wide range of power levels and voltages with a high degree of accuracy over the frequency range of 10 kc to 15.1 mc.

It may be used to measure signal or carrier levels, harmonics, noise, crosstalk, or interfering signals in communications systems or communications receiving and transmitting equipment. It can also be synchronously tuned by a Tracking Signal Generator* when making a frequency run on a transmission line or circuit of a communications system. Either a narrow or wide bandwidth mode of operation is available in the instrument. Since the Voltmeter may be operated from either an ac or battery power source, it is readily adaptable for use in the field, at a communications terminal or in the laboratory.

B. DESCRIPTION

The Model 128A is a fully transistorized instrument employing modular circuit boards for component mounting. To provide adequate shielding for low level signals and stability of operation of the frequency generating sections, four aluminum castings are used to enclose a large part of the instrument circuitry. The castings are internally divided into compartments, each of which contains a circuit board assembly. This construction provides a high degree of isolation between circuits. The remainder of the circuit board assemblies are mounted on the chassis or the front panel. Shielded compartments are also used for these circuits where necessary.

The voltmeter may be tuned either continuously or frequency locked every 100 kc. Frequency lock is indicated by a relay operated panel lamp. Both aural (relay click) and visual (panel lamp) indication of the locked condition are thus furnished. For frequencies intermediate to the 100 kc points an Incremental Oscillator is used. The tuned frequency is the sum of the frequencies indicated by the Main Tuning and Incremental Tuning dials.

Input circuits of the Frequency Selective Voltmeter may be set for either the terminating or bridging mode. The termination mode provides a termination impedance to match either 75, 135 or 600 ohm lines or circuits. In the bridging mode the input impedance is sufficiently high, approximately 100,000 ohms, to insure a low bridging loss. Refer to Block Diagram Figure 1-2 for relationships of the various circuits.

*Sierra Model 351A

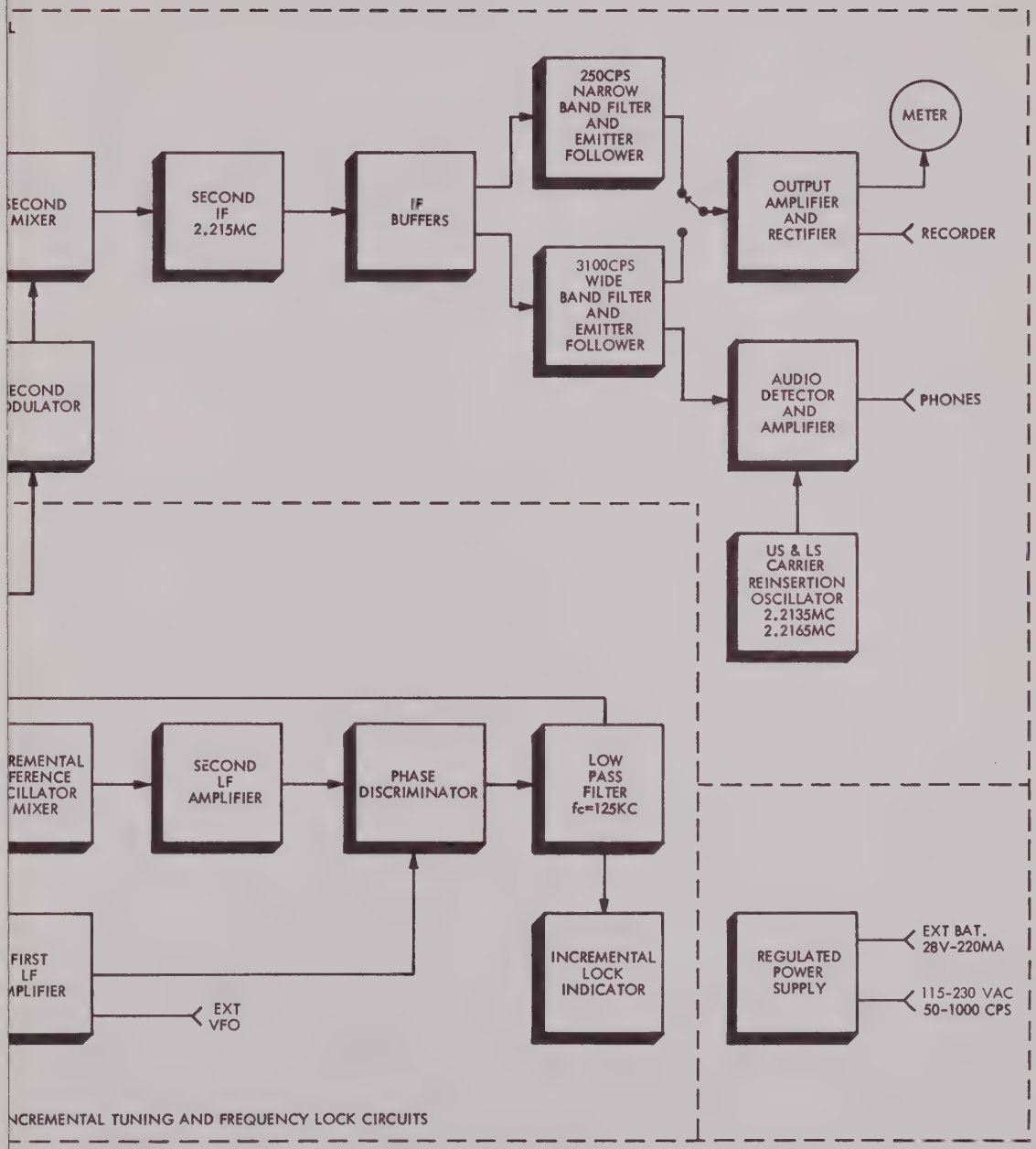


Figure 1-2.
Model 128A Block Diagram

The Input Attenuator is adjustable in 10 db steps and is calibrated from -90 dbm to +30 dbm. The Attenuator is also calibrated in volts, the panel scale range being from 30 μ volts to 30 volts. To measure voltage the input must be set to the 600 ohm position.

Operational calibration of the instrument is provided by an internal Gain Reference oscillator. The output of this 1 mc crystal controlled oscillator is highly stabilized.

Wide or Narrow bandwidth is selected with a front panel control. This control switches the proper crystal band-pass filter into the circuit to provide the selected bandwidth. Audio modulation on the signal may be continuously monitored through the wide band filter, the output of which is permanently connected to the input of the audio amplifier.

Monitoring of single sideband carrier systems is provided for by internal carrier re-insertion oscillators. Either sideband may be selected with a front panel switch.

A recorder output is available with an output of 0-200 μa through a resistance of not more than 1200 ohms.

To provide for synchronous tuning of the Frequency Selective Voltmeter by means of a Tracking Signal Generator, input connectors are mounted on the dial panels of both the Main Tuning Oscillator and the Incremental Tuning Oscillator.

Dial drives of both oscillators have coarse and fine tuning controls. The dial calibrations are on a spiral scale and a cursor index automatically moves to indicate the proper reading point on the dial. This provides a long scale with widely spaced scale divisions.

Both tuning dials are fitted with a cursor adjustment as a front panel control The index on the cursor may be set to the proper point on the dial scale using the internal one megacycle Gain Reference oscillator.

C. SPECIFICATIONS

FREQUENCY RANGE	10 kc to 15.1 mc
Main Tuning	
Locked, in 100 kc steps	0, 100, 200 kc. . 15 mc
Unlocked, continuous	0 to 15.1 mc
Incremental Tuning	
Continuous	- 10 to 100 kc
Minimum Reading Increment	500 cycles
Accuracy, lock system actuated	±(20 ppm + 300) cycles

Frequency Stability	
Short Term (At normal room ambient temperature over any 15 minute period after a two hour warmup)	5 cycles
Long Term (At normal room ambient temperature over any eight hour period after a two hour warmup	50 cycles

AUTOMATIC TRACKING TUNING

Required from external Tracking Signal Generator	
Main Tuning Frequency	21.1 mc to 36.1 mc
Incremental Tuning Frequency	200 kc to 300 kc

INPUT LEVEL RANGE

DBM (75Ω, 135Ω, 600Ω)	-90 to +32 dbm full scale
Minimum Reading Level	-110 dbm
Voltage range (600Ω position only)	30μv to 30 volts full scale

MEASUREMENT ACCURACY

At reference frequency of 1 mc and 0 dbm level	±0.2 db
Frequency response referred to 1 mc	
In Attenuator Positions -70 db to +30 db	
100 kc to 10 mc	±0.2 db
10 kc to 15 mc	±0.5 db
In Attenuator Positions -90 db to -80 db	
10 kc to 10 mc	±0.5 db
10 kc to 15 mc	±0.7 db
Attenuator Accuracy, Referenced to 0 dbm	
Over the Frequency Range 100 kc to 1 mc	
-90 db to +30 db	±0.1 db
Over the Frequency Range 10 kc to 5 mc	
-90 db to +30 db	±0.2 db

Over the Frequency Range 5 mc to 10 mc	
-70 db to +20 db	±0.2 db
-90 db to +30 db	±0.3 db
Over the Frequency Range 10 mc to 15 mc	
-70 db to +20 db	±0.3 db
-90 db to +30 db	±0.8 db
Variation in accuracy due to line voltage	
Variation of ±10%	0.1 db
Level Calibration Frequency	1 mc, Crystal Controlled

INPUT IMPEDANCE

Bridging Mode	Unbalanced
Resistance	Greater than 100KΩ
Capacitance	
Attenuator Setting	
-60 db to +30 db	30 pf approximately
-90 db to -70 db	60 pf approximately
Terminating Mode	75Ω, 135Ω, 600Ω
Reflection Coefficient	Less than 5%

SELECTIVITY

Bandwidths (Switch Selected)	2
Wide (Crystal Filter)	3100 cps ±200 cps (3 db points)
	8000 ±500-1000 cps (60 db points)
Narrow (Crystal Filter)	250 cps ±50 cps (3 db points)
	1000 cps ±100 cps (60 db points)

INTERMEDIATE FREQUENCIES (Dual Conversion)

First IF	21.0 to 21.11 mc
Second IF	2.215 mc

SPURIOUS RESPONSES	
Image Frequency Rejection (42 to 57 mc)	70 db down
Direct First IF Response (21.0 to 21.11 mc)	70 db down
Direct Second IF Response (2.215 mc)	80 db down
Residual Distortion Attenuation	
For Input Fundamental Frequencies of 100 kc to 2 mc	Greater than 65 db with an increase in sensitivity of 50 db
For Input Fundamental Frequencies of 10 kc to 100 kc and 2.0 mc to 7.5 mc	Greater than 65 db with an increase in sensitivity of 40 db
AUDIO	
Audio Monitor	Continuous operation independent of bandwidth mode
Detection	
Amplitude Modulation	AM Detector
Single Sideband	Carrier Reinsertion Combined AM Detector
Output	Phones (600Ω minimum impedance)
Recorder Output	
Load Impedance	No greater than 1200Ω
Output Level (Current)	0 to 200 μA through load impedance
Output Connector	Telephone Jack
TEMPERATURE RANGE	+15°C to +40°C
POWER REQUIREMENT	
Line Power	115/230V AC ±10% 50-1000 cycles, 15VA
External Battery	28 volts dc, 220 ma drain

OVERALL DIMENSIONS (Cabinet)	
Width	20 inches
Height	12 inches
Depth	14 inches
Rack Mounting (Cabinet Removed)	Standard 10-1/2" H x 19" W
WEIGHT (In Cabinet)	50 pounds approximately

ACCESSORIES

A Balanced Probe, Model 128-PA, an Expanded Scale Meter, Model 128-MA, and a speaker kit are available as accessories to the Model 128A, Frequency Selective Voltmeter. The description and specifications for these accessories are provided as an addendum to this manual.

An accessory Equipment Console, Model 220A-1 is available for use with the Model 128A Frequency Selective Voltmeter. This unit permits console mounting of the Model 128A plus various accessory equipments including a Spectrum Display Unit, Model 360A, a Tracking Signal Generator, Model 351A and other accessory equipments as shown in the Model 220A-1 addendum.

SECTION II
OPERATION

A. CONTROLS AND INDICATORS

The front panel controls and indicators are listed below along with a brief indication of their use and the schematic reference number.

1. MAIN TUNING MEGACYCLES

Control or Indicator	Use	Schem. Ref. No.
COARSE	Coarse Adjustment MAIN TUNING	C1
FINE	Fine Adjustment MAIN TUNING	C1
CURSOR	Index Adjustment MAIN TUNING	
LOCK INDICATOR	Mode Indicator MAIN TUNING	DS1
TRACKING SIGNAL INPUT MC	Input for Synchronous Tuning	J2

2. INPUT

Control or Indicator	Use	Schem. Ref. No.
INPUT	GR Locking Input Connector	J1
DBM-VOLTS	Input Attenuator	S2
CAL - 75Ω - 135Ω - 600Ω	Input Impedance Selector	S4
BRG TERM	Input Mode Selector	S3

3. FUNCTION

Control or Indicator	Use	Schem. Ref. No.
CAL	Adjustment for Operational Calibration	R34
SELECTIVITY PWR OFF WIDE NARROW	Instrument Power On-Off Bandwidth Selector	S1
LOCK CONT MAIN TUNING	MAIN TUNING Mode Selector	S5

4. INCREMENTAL KILOCYCLES

Control or Indicator	Use	Schem. Ref. No.
COARSE	Coarse Adjustment INCREMENTAL Tuning	C1
FINE	Fine Adjustment INCREMENTAL Tuning	C1
CURSOR	Index Adjustment INCREMENTAL Tuning	
LOCK INDICATOR	Mode Indicator INCREMENTAL Tuning	DS2
TRACKING SIGNAL INPUT KC	Input for Synchronous Tuning	J3

5. AUDIO

Control or Indicator	Use	Schem. Ref. No.
MODE LS AM US	Detector Mode Selector	S6
GAIN	Audio Output Level Adjustment	R39
PHONES	Audio Output	J4

6. READOUT

Control or Indicator	Use	Schem. Ref. No.
Meter	Dbm or Volts	M1
RECORDER	Output for Recorder (on rear of chassis)	J5

B. OPERATIONAL CALIBRATION

Procedure for Operational Calibration sets the overall sensitivity of the voltmeter for all of its ranges. The highly stabilized Gain Reference Oscillator, the output of which is nominally within ±0.1 db under room ambient conditions, is used as the standard. (Level calibration must be carried out at the 1 mc frequency only.) Procedure follows:

1. Set INPUT DBM-VOLT attenuator to CAL. (Full clockwise rotation.)

2. Set INPUT Impedance selector to CAL-75Ω.

3. Set SELECTIVITY switch to NARROW.

4. Place FUNCTION MAIN TUNING Mode selector in LOCK position.

5. Set MAIN TUNING MEGACYCLES dial to 1 mc (LOCKED light will come on to indicated frequency locked condition.)

6. Set INCREMENTAL KILOCYCLES dial to 0 and carefully adjust tuning for maximum meter reading.

7. Adjust CAL control until meter reads 0 dbm.

8. If necessary set the cursor index directly over 0 mark on INCREMENTAL Tuning dial using CURSOR adjustment. If it is desired to set cursor on MAIN TUNING dial, set the dial, in the locked condition at 1 mc, or any harmonic, so that it is half way between the points at which it goes out of lock. With the CURSOR adjustment, set index directly under the 1 mc scale division mark, or at any of the harmonics of 1 mc.

C. OPERATIONAL MEASUREMENTS

1. INPUT DBM-VOLTS Attenuator should be turned full clockwise to +30 dbm, or CAL, before connection is made to line or circuit, as a precautionary measure.

2. Perform Operational Calibration as outlined in B. above.

3. Set INPUT Impedance selector to the impedance of line or circuit to be checked, or to 600Ω if voltage is to be measured.

4. Set INPUT Mode selector to BRG if measurement is to be made across a line or circuit already terminated. Set to TERM if the line must be terminated in its characteristic impedance.

5. If frequency of desired signal is known:

   a. Set SELECTIVITY switch to WIDE.

   b. Set FUNCTION MAIN TUNING Mode selector to LOCK.

   c. Set INPUT DBM-VOLTS Attenuator to approximately the expected signal level.

   d. Set INCREMENTAL Tuning dial to 0 kc.

   e. Set the MAIN TUNING frequency dial to the nearest 100 kc lock point below the signal frequency.

   f. Adjust INCREMENTAL Tuning for maximum meter reading.

   g. Adjust Attenuator for a meter reading between -10 and +2 db.

   h. Set SELECTIVITY switch to NARROW and again adjust INCREMENTAL Tuning for maximum meter reading.

6. If frequency of signal to be measured is not known, or only approximately known:

   a. Follow procedure steps a. through d. as given in paragraph 5. above, except that MAIN TUNING Mode selector should be set to CONT.

b. Rotate MAIN TUNING dial until an indication is seen on the meter. If necessary, set attenuator to progressively lower (greater sensitivity) levels and search for signal until a meter indication is obtained. Reduce sensitivity if meter "kick" seems large when passing over signal. A signal 20 db below the attenuator setting may be readily found with careful tuning.

c. Set MAIN TUNING Mode selector to LOCK and follow procedure e. through h. in paragraph 5. above.

7. Readout

a. DBM levels. (Assuming INPUT Impedance selector set to proper line impedance and line properly terminated.) Signal level is the algebraic sum of the attenuator db setting and the meter reading.

Example: Attenuator -20 dbm, Meter -4 dbm.
(-20) + (-4) = -24 dbm

Example: Attenuator -20 dbm, Meter +1 dbm.
(-20) + (+1) = -19 dbm

Example: Attenuator +20 dbm, Meter -4 dbm.
(+20) + (-4) = +16 dbm

b. Voltage Levels. (Assuming INPUT Impedance selector is set to 600Ω.) The meter has two voltage scales, 0-1 and 0-3. The attenuator range settings 100μ, 1m, .01, .1, 1, 10 volts apply to the 0-1 scale. The range settings 30μ, 300μ, 3m, .03, .3, 3, 30 volts apply to the 0-3 scale. Each attenuator range setting refers to the maximum voltage that can be read on the appropriate meter scale.

Example: Attenuator 1m, Meter .8
Read .8 millivolts, or 800 microvolts.

Example: Attenuator .03, Meter 1.5
Read .015 volts

c. Frequency. The frequency to which the voltmeter is tuned is the sum of the MAIN TUNING dial indication in megacycles plus the INCREMENTAL Tuning dial indication in megacycles (kilocycles reading converted to megacycles).

Example: MAIN TUNING 11.3 mc, INCREMENTAL Tuning 34.5 kc.
Frequency = 11.3 mc + .0345 mc = 11.3345 mc

8. Recorder Output

If a record of signal level changes on the line or circuit being monitored is desired, a recording device may be driven from the rear chassis jack marked RECORDER. The recording device will then be in series with the meter, but will not affect the meter reading as long as the recorder input resistance is 1200 ohms or less. Since the meter has a 200 microampere movement, approximately 200 microamperes through the recorder input will correspond to +2 dbm.

D. LOCK ADJUSTMENT

1. If the INCREMENTAL Tuning oscillator tends to drop out of the locked condition, LOCK indicator light goes out and does not come on again immediately, the LOCK ADJ control may be adjusted to restore normal operation if the condition is due to normal aging and change in components of the tuning lock circuits.

Before making the adjustment, be certain that the indicator light is not burned out and that normal indications are being obtained on the panel meter of the voltmeter.

The ADJ control is a 26 turn potentiometer with idler at end of travel. The control has been factory set at mid-range.

2. Adjustment Procedure

a. Set the voltmeter Attenuator to CAL, 75 ohm/BRG, SELECTIVITY to WIDE, MAIN TUNING mode to LOCK, MAIN TUNING dial to 1.0 Mc, locked, and the INCREMENTAL dial to 0.0 kc. Tune for maximum indication.

b. Turn the ADJ control a few turns in either direction and rotate the INCREMENTAL dial through its range to check for proper LOCK indication, LOCK light stays on. Continue adjustment and checking until LOCK light stays on over the full travel of the INCREMENTAL dial when rotated at a reasonable speed.

c. Set the INCREMENTAL dial to 0.0 kc and tune for maximum indication.

d. Set the MAIN TUNING dial to 0.9 Mc, locked, the INCREMENTAL dial to 100 kc and tune for maximum indication. Rotate the INCREMENTAL dial through its full travel to check that LOCK light stays on.

e. If LOCK light will not stay on with the adjustment of paragraph b., or if normal indication is not obtained in c. or d., the trouble is probably located in another part of the circuit.

SECTION III
CIRCUIT DESCRIPTION

A. SIGNAL CHANNEL

This division of the circuit description includes the circuits in the main signal path through the instrument from input to outputs. In addition, the Carrier Reinsertion oscillators and the Gain Reference oscillator are described. Refer to Schematic Diagram Figure 3-5 and to Block Diagram Figure 1-2.

1. Input Matching and Attenuator Circuits

a. Impedance and Level Adjustment. The proper load termination impedance to match 75Ω, 135Ω, and 600Ω lines may be selected when INPUT Mode selector switch S3 is in the TERM position. The correct line impedance is selected by INPUT Impedance selector switch S4A. S4B-S4C sections of this switch function in either TERM or BRG Input Mode to select the proper level-adjusting network. Level to the preamplifier must be set to compensate for the different voltage levels corresponding to zero dbm across the various line impedances.

b. Attenuator. The input attenuator is a capacitive divider network which functions to keep the input signal level to the preamplifier within the limits required for the full scale range of the output meter. Thirteen attenuator positions in 10 db steps, selected by switch S2A-S2B, cover the range from -90 to +30 dbm. Attenuation is reduced to increase sensitivity for every step except for the -90 dbm position. In this position switch S2C operates a relay in the Output Amplifier circuit which increases the amplifier gain by 10 db to provide -90 dbm full scale sensitivity.

2. Preamplifier

A wide-band well stabilized preamplifier provides an impedance match between the high impedance of the input attenuator and the low impedance of the input filter without sacrificing gain. Q1 is collector bootstrapped with feedback from Q2 to provide a high input impedance and a suitable frequency response characteristic. Q3 includes a frequency response adjustment network in the emitter circuit for flattening the response out to 15 mc.

3. Input Low-Pass Filter

Attenuation of all frequencies above the range of the instrument is accomplished by a four section low-pass filter. It is essentially flat over the pass-band range and cuts off at about 16 mc. The filter is made adjustable to provide for more precise overall alignment.

4. First Mixer, First Modulator and First IF

Frequency conversion from the signal frequency at the instrument input to the first intermediate frequency of 21.05 mc is carried out in the First Mixer. The signal at the input frequency is applied to the base of the mixer transistor Q1. The output of the Main Tuning Oscillator is applied to the First Modulator. The output of this balanced Modulator is connected across the emitter resistor of Mixer transistor Q1. Since the Modulator output is balanced to ground, the Main Tuning Oscillator frequency does not appear in the output, but the RF impedance of the modulator output varies at the Main Tuning Oscillator frequency rate. This varying impedance, connected across the emitter resistance of the Mixer transistor, causes the gain of Q1 to vary at this rate. The effect is to generate the sum and difference frequencies of the signal and Main Tuning Oscillator frequencies, but to practically eliminate the MAIN TUNING Oscillator frequency. The first IF circuit, which provides the load for the collector of the Mixer amplifer, is tuned to the difference frequency of 21.05 mc and thus only this frequency is amplified. The First IF circuit is a steep skirted band-pass filter with a very flat response over a bandwidth of about 150 kc, centered on 21.05 mc. This bandwidth is necessary in order to accommodate signals 50 kc above and below the center frequency of the first IF stage, as the voltmeter is tuned between the 100 kc lock points with the Incremental Tuning Oscillator. Extreme flatness prevents change in gain over this bandwidth.

5. Second Mixer and Second Modulator

The Second Mixer and Modulator circuits operate in a manner similar to the First Mixer and Modulator. Input to the Second Modulator is from the Second Oscillator. First IF signal and Second Modulator output into the Second Mixer produce the second intermediate frequency of 2.215 mc. The Second Mixer has a single tuned circuit in the collector, tuned to the second intermediate frequency, as does the first stage of the Second IF amplifier to which the output of the Second Mixer is fed.

6. Second IF Amplifier

a. IF Buffer Amplifiers. After passing through the initial stage of the Second IF amplifier, the signal is applied to the two IF Buffer amplifiers. These common-emitter stages not only separate the signal into two parallel channels, but also make it possible to provide the correct source impedance for the two crystal filters connected to their outputs.

b. Crystal Filters. The Crystal Filters, FL1 and FL2, determine the overall selectivity of the Frequency Selective Voltmeter. Both filters are centered on 2.215 mc. The NARROW band filter, FL2, has a bandwidth of 250 cycles, while the WIDE band filter, FL1, has a bandwidth of 3100 cycles, unless otherwise specified.

c. Narrow and Wide Band Followers. Each crystal filter is followed by an emitter-follower stage. The amplifiers supply the narrow band or wide band signal to the Output Amplifier as either channel is selected by SELECTIVITY switch, S1B,

S1C, S1D. A second emitter-follower, Q2, on the Wide Band module takes off the signal ahead of the switch and feeds it to the Audio Amplifier. Thus the signal is always connected through the Wide Band Follower to the Audio output circuits for audio monitoring purposes.

7. Meter Output Amplifiers and Rectifier

From either the Narrow or Wide Band Followers the signal goes to the Output Amplifier module. The stages in this amplifier operate at the second intermediate frequency. The first two, selective tuned, stages are separated from the rest by a shield placed across the module circuit board.

Gain in the first stage is increased 10 db when relay, K1, is closed, actuated by Attenuator switch, S2, when it is placed in the -90 dbm position, as noted in paragraph A.1.b. R2 and part of R4 are shunted out by the relay, increasing the voltage and changing the dc operating point to obtain the additional gain. To insure maximum gain stability, this stage is temperature stabilized by shunting part of the emitter resistor with a thermistor, RT1.

The gain of the second stage, Q2, is adjusted by front panel CAL control, R34, for operational calibration level adjustment. To provide for initial and maintenance calibration the gain of Q3 is varied by adjusting degeneration with the internally mounted control R19. This stage is broadly tuned to the second intermediate frequency.

The meter rectifier circuit is driven by the two stage, R-C coupled, feedback amplifier Q4-Q5. A large amount of negative feedback is used for stability and output linearity. The rectifier circuit is a modified bridge composed of CR1, CR2, C22, C23. Residual IF is filtered out of the meter circuit with L7-C24, L8-C25.

A closed circuit jack in series with the meter circuit is included to provide a recorder output. As long as the resistance introduced into the circuit by the recorder input is not more than 1200 ohms the meter reading will not be affected. This is possible since the feedback amplifier is in effect a constant current source.

8. Audio Amplifier and Detector

From the second Wide Band emitter-follower, Q2, the signal is fed to the Audio module where it is amplified at the second intermediate frequency in a selective tuned amplifier Q1. The output of Q1 is connected to Q2 which functions as either an AM or Sideband detector. An audio amplifier, Q3-Q4, raises the output of the detector to a level suitable for headphone operation. The signal is brought out to the PHONES jack through an emitter-follower, Q5, which makes possible the use of either high or low impedance phones. Audio level is adjusted by front panel AUDIO GAIN control, R39.

9. Carrier Reinsertion Oscillators (On Audio Circuit Board)

When the output of either of the carrier reinsertion oscillators is applied to the input of the detector, Q2, sideband modulation may be recovered. The oscillators are crystal controlled and each is followed by an emitter-follower to prevent excessive loading of the oscillator circuit. The oscillator frequencies are: one 1500 cycles above and one 1500 cycles below the second intermediate frequency. Either oscillator, or neither for AM, is selected by front panel switch S6 which controls the collector current supply to the oscillators.

10. Gain Reference Oscillator

The 1 mc crystal controlled oscillator, Q3, with the compound connected squaring amplifier, Q1, Q2, produces a rectangular signal suitable for the routine calibration of the Voltmeter. Output level is highly stable, variation being less than 0.1 db at normal ambient temperatures. Harmonics of the 1 mc frequency are accentuated in the network composed of L1-C1-R1 so that frequency check points are available over the full frequency range of the Voltmeter. Placing the INPUT Attenuator switch in the CAL position applies B- power to energize the oscillator.

NOTE: Level calibration must be carried out at the 1 mc frequency only.

B. MAIN TUNING AND FREQUENCY LOCK CIRCUITS

Nine circuit board modules mounted in compartments of the MAIN TUNING casting hold the components making up these circuits. See Schematic Diagram Figure 3-5.

1. Main Tuning Oscillator

The Main Tuning Oscillator uses a highly stabilized Colpitts circuit and is tuned by MAIN TUNING capacitor C1 over the range 21.1 mc to 36.1 mc.

a. Locked Mode. In this mode, MAIN TUNING Mode selector switch S5 in the LOCK position, the oscillator is locked on frequency every 100 kc over its full range by means of an error voltage applied to the varactor diode, CR1. The varactor diode is shunted across the oscillator tuning capacitor C1. The error voltage applied to the diode causes its effective capacity to vary in such a direction that the oscillator is maintained in a harmonic relationship with the 100 kc oscillator over a narrow tuning range around each 100 kc harmonic point. Generation of the error voltage is accomplished in the frequency lock circuit to be described in the following paragraphs, 2 through 4.

The Main Tuning Oscillator output passes to the input of two amplifiers, one located on the same circuit board and another separately mounted and designated as the Main Tuning Follower. Oscillator output is fed to this module through a relay, K1, which may be used to introduce an external signal into the Main Tuning Follower

for synchronous tuning operation. See below, sub-paragraph c. The Main Tuning Follower output goes through J8 to the input of the First Modulator for frequency conversion of the main signal to the first intermediate frequency. (Parallel connected jack, J9, is used in alignment procedures only.) The other output of the Main Tuning Oscillator passes through an amplifier, Q2, mounted on the Main Tuning Oscillator circuit board, to the Main Tuning Mixer.

b. Continuous Mode. When the MAIN TUNING Mode selector switch, S5, is placed in the CONT position, collector B- supply is disconnected from the 100 kc Oscillator and the Main Lock Indicator modules. At the same time a fixed bias is applied to the varactor diode, CR1, in the Main Tuning Oscillator circuit. Under these conditions the Voltmeter frequency can be tuned continuously over the full range with the MAIN TUNING Oscillator control, C1, and the frequency to which it is tuned will be indicated by the reading of the MAIN TUNING dial.

c. Tracking Signal Input. For synchronous tuning of the Frequency Selective Voltmeter a signal from an external Tracking Signal Generator is brought in through front panel connector, J2, marked TRACKING SIGNAL MC INPUT. This signal takes the place of the Main Tuning Oscillator output. Control DC to automatically operate relay K1, as well as the external signal, is carried by the center conductor of the connecting cable from the Tracking Signal Generator. When K1 is actuated the B- supply is disconnected from: the Main Tuning Oscillator, Main Tuning Mixer, 100 kc Oscillator and the Main Lock Indicator. At the same time the external signal is connected to the input of the Main Tuning Follower amplifier and fed to the First Modulator. (Refer also to paragraph, Tracking Signal Input Control, under Incremental Tuning Oscillator.) When these two Tracking Signal connections are made, tuning of the Voltmeter is completely controlled by, and is synchronous with, the external Tracking Signal Generator.

2. 100 kc Oscillator and Harmonic Generator

The crystal controlled 100 kc oscillator provides the highly accurate frequency which determines the 100 kc lock points for the Main Tuning Oscillator frequency dial settings. The oscillator, Q1, is connected in a Colpitts circuit. Output is a sine wave which is applied to the input of a Schmitt trigger, Q2-Q3. Since there is an inductance, L2, in the collector circuit of Q3, the Schmitt trigger output has a peaked waveform rich in high order harmonics, which is the desired condition. The oscillator output is isolated from the low impedance input of the Main Tuning Mixer by emitter-follower stage Q4.

3. Main Tuning Mixer

The peaked waveform output of the 100 kc Oscillator and Harmonic Generator is applied to the primary of the Main Tuning Mixer transformer T1 where, due to the resonant rise across the transformer inductance, it becomes still more sharply peaked. The negative swing is cut off by diode CR1, leaving a narrow positive going pulse as the waveform in the transformer primary.

The output of the Main Tuning Oscillator is applied to the center-tap of the secondary of T1. The combined inputs to T1 are applied to diodes CR2-CR3 which, since they conduct in only one direction, allow an output only for the duration of each 100 kc pulse.

The output to the Amplifier Detector is therefore a wave containing components of both the Main Tuning Oscillator frequency and the fundamental and harmonics of the 100 kc frequency. When the Main Tuning Oscillator frequency is exactly a harmonic of the 100 kc oscillator frequency, the output appears as a 100 kc pulse. See Figure 3-1, which shows the pulse after being rectified in the detector.

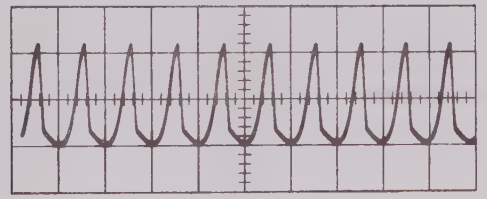
The 100 kc pulses are of constant amplitude provided the Main Tuning Oscillator frequency does not attempt to drift, or the Main Tuning Capacitor is not changed slightly. If either of these situations occur the pulses increase or decrease in amplitude, depending on the direction of attempted frequency change. This change in amplitude is due to change in phase relationships between the 100 kc pulse and the Main Tuning Oscillator signal, and is detected by the following circuits. Such a change generates an error voltage which is immediately applied to the varactor diode and changes its effective capacity slightly. The capacitance change is in the proper direction to maintain the Main Tuning Oscillator frequency in harmonic relation to the 100 kc signal. Thus in the locked condition the frequency of the Main Tuning Oscillator does not vary. Error voltage is developed by change in phase relationships only.

When the Main Tuning Oscillator is not in the locked condition the amplitude of the 100 kc pulses continuously vary. See Figure 3-2. The frequency of the envelope of these variations is the difference between the Main Tuning Oscillator frequency and the frequency of the nearest 100 kc harmonic, and thus will never be greater than 50 kc. In this condition the Main Lock Indicator light goes out.

4. Amplifier Detector, Low-Pass Filter and Main Lock Indicator

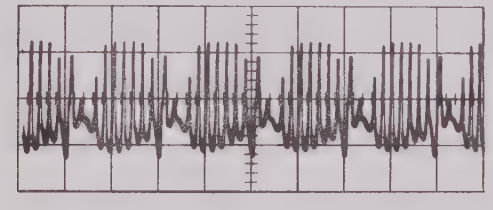
Output from the Main Tuning Mixer is passed through an emitter-follower, Q1, and a common-emitter amplifier, Q2, in the amplifier Detector module and applied to the base of the detector stage, Q3. The detector output is connected to the Low-Pass Filter, a two stage unit with a cutoff frequency of 50 kc.

When the 100 kc pulses out of the Mixer are of constant amplitude, the 100 kc modulation recovered by the detector is removed by the low-pass filter, and the filter output is a dc voltage which is proportional to average pulse amplitude. A change in average pulse amplitude will therefore cause a change in dc voltage. This is the error voltage that is applied to the varactor diode to maintain the Main Tuning Oscillator on frequency, in the locked condition. See Figure 3-3.



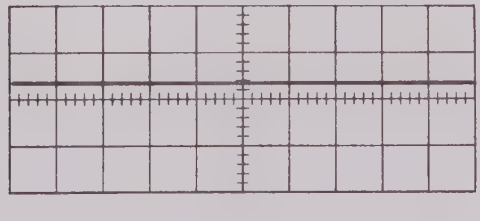
Hor: 10 μs/cm

Figure 3-1. 100 kc Pulses, Locked Waveform, Amplifier Detector Output



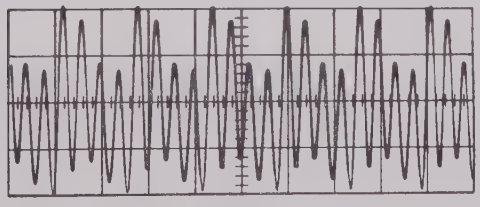
Hor: 50 μs/cm

Figure 3-2. 100 kc Pulses, Unlocked Waveform, Amplifier Detector Output



Hor: 50 μs/cm

Figure 3-3. Locked Waveform, Main Tuning Low Pass Filter Output



Hor: 50 μs/cm

.Figure 3-4. Unlocked Waveform, Main Tuning Low Pass Filter Output

When the pulses are continuously varying in amplitude, the unlocked condition, the modulation envelope is detected. Since the envelope frequency is always less than 50 kc, as noted above, this alternating signal passes through the low-pass filter. See Figure 3-4.

The alternating signal out of the low-pass filter is amplified by Q1 in the Main Lock Indicator module and applied to the input of the Schmitt trigger Q2-Q3. This circuit is adjusted to trigger on at a very low ac voltage so that Schmitt-trigger output occurs as soon as the Main Tuning Oscillator lock control is lost. The trigger output flows through relay K1, causing it to open and the LOCKED indicator light to go out.

The same alternating voltage is applied to the varactor diode, but because it fluctuates rapidly it will not cause the oscillator to lock in. When the Main Tuning Oscillator is adjusted so that it is close to a 100 kc harmonic frequency and the alternating voltage frequency is reduced sufficiently, a point is reached at which the lock circuits take control; the low pass filter output becomes dc, the Schmitt trigger in the Main Lock Indicator module is cut off and the LOCKED indicator light comes on.

C. INCREMENTAL TUNING AND FREQUENCY LOCK CIRCUITS

Eight circuit board assemblies make up the Incremental Tuning and Frequency lock circuits. Each board is mounted in a separate compartment of the INCREMENTAL tuning casting which sets on the right side of the instrument. See Schematic Diagram Figure 3-5.

1. Incremental Tuning Oscillator and First LF Amplifier

Adjustment of the Frequency Selective Voltmeter to frequencies between the 100 kc harmonic points selected by the Main Tuning Oscillator control is accomplished with the Incremental Tuning Oscillator. This is a very stable Clapp oscillator covering the frequency range of 200 kc to 310 kc, tuned with front panel mounted capacitor C1. Tuning dial calibration is from -10 to 0 to 100 kc, providing a range that overlaps the 100 kc lock points of the Main Tuning Oscillator.

Oscillator output is amplified in the common-emitter stage Q1, of the First LF Amplifier module. Output then passes through the contacts of relay K1, through two emitter-follower stages, Q2-Q3, to the primary of T1 in the Phase Discriminator module. The power gain of the emitter-follower stages furnishes the signal level required in the primary of T1.

Tracking Signal Generator control for synchronous tuning is fed in through J3 and relay K1. When the connection is made from the external Tracking Signal Generator, dc control voltage carried by the interconnecting cable actuates K1. At this time the Incremental Tuning Oscillator output is disconnected from the circuit, and the Tracking Signal Generator signal is connected to emitter-follower Q2 in its place. See also paragraph B.1.c. above.

2. Second Oscillator

To make the frequency conversion from the First IF band of 21.000-21.110 mc to the second IF of 2.215 mc, the Second Oscillator tunes over the range of 18.785 mc to 18.895 mc. Tuning is accomplished solely by means of varactor diode CR1. This is a voltage variable capacitor connected in the tuned circuit of the Second Oscillator. It functions in a similar manner to the varactor diode in the Main Tuning Oscillator. Adjusting the Incremental Tuning Oscillator causes the voltage across CR1 to be changed by means of the circuits to be described shortly, providing exact control of the Second Oscillator frequency.

Output of Second Oscillator, Q1, is applied to the base of each of two emitter-follower amplifiers, Q2-Q3, both mounted on the Second Oscillator module circuit board. The output of Q2 is fed through J20 to the input of the Second Modulator. (Parallel jack, J19, is provided for use in alignment procedures.) From the output of Q3 the signal is applied to the center tap of the mixer transformer in the Incremental Reference Oscillator and Mixer module through common-emitter isolation amplifier, Q2.

3. Incremental Reference Oscillator and Mixer, and Second LF Amplifier

Control of the Second Oscillator by the Incremental Tuning Oscillator requires the intermediate step in frequency generation provided by the Incremental Reference Oscillator. This is a crystal controlled Colpitts oscillator operating on a frequency of 18.585 mc. The oscillator output is fed into the primary of mixer transformer T1. A signal from the Second Oscillator is fed into the center tap of the secondary of this same transformer through isolation amplifier Q2. These signals are mixed in the output circuit to form a difference frequency which is taken out at the arm of potentiometer, R7. The difference frequency, determined by the tuning of the Second Oscillator, covers the range of 200 to 310 kc.

Mixer output goes to the Second LF Amplifier, made up of a common-emitter and an emitter-follower stage, where the signal is raised to a suitable level for application to the Phase Discriminator.

4. Phase Discriminator and Low-Pass Filter

In this circuit the 200-310 kc frequency of the Incremental Tuning Oscillator is fed into the primary of T1. The 200-310 kc output of the Incremental Reference Oscillator Mixer is fed into the primary of T2. The output connections of the secondaries of these transformers, the diodes CR1-CR2 and associated components form the phase discriminator circuit. When the two input signals are the same frequency, the output appears as a half-wave rectified signal. This signal passes to the Low-Pass Filter. Since the cutoff frequency of this filter is 125 kc, the signal frequency components are filtered out and the output is a dc voltage proportional to the average amplitude of the rectified signal components. As long as the two signals are of the same frequency, the average level of the signal components will change as phase relationships between the two input signals change.

The dc voltage output of the Low-Pass Filter is connected to the varactor diode in the Second Oscillator and controls the frequency of this oscillator. Control is sufficient to keep the Second Oscillator continuously locked to the Incremental Tuning Oscillator over its full range of tuning. Since the Second Oscillator output frequency when mixed with the output of the Incremental Reference Oscillator must generate an output that is the same frequency as that of the Incremental Tuning Oscillator for locking to take place and continue, the control of the Incremental Tuning Oscillator over the Second Oscillator is exact. Therefore, the oscillators are in the phase locked condition for every setting of the Incremental Tuning Oscillator dial.

5. Incremental Lock Indicator

When the input signals to the Phase Discriminator are not exactly the same frequency, a beat frequency output is produced. This beat will be low in frequency and cannot be greater than 110 kc in the extreme case (the difference between 200 and 310 kc), so it readily passes through the low-pass filter to actuate the Incremental Lock Indicator. As in the Main Lock Indicator, any alternating signal at the input is amplified and actuates the Schmitt trigger, causing the contacts of relay K1 to open and the LOCKED indicator light to go out.

The unlocked condition normally will only occur for a short period after the instrument is turned on, or if the Incremental Tuning Oscillator dial is rotated very rapidly. This unlocked condition will be only momentary since the lock circuit is very rapid in its action. Diodes CR3-CR4 and associated circuitry on the Phase Discriminator Module aid in the rapid take-over of control for the locked condition.

To provide for any possible change in locking characteristics with passage of time, the LOCK ADJ control, R1, a 26 turn continuous travel potentiometer, located just to the right of the INCREMENTAL LOCK indicator light on the front panel, is provided. The control adjusts a fixed bias on the varactor diode, CR1, in the Second Oscillator circuit to restore the Second Oscillator frequency to the means of the locking range. Schematically the potentiometer is connected to the Incremental Tuning Oscillator circuit board.

D. POWER SUPPLY CIRCUITS

A 16 volt regulated supply provides power for the voltmeter circuits. Input to the supply may be either 230 volts ac, 115 volts ac or 28 volts dc. The supply is mounted on one circuit board and consists of a solid state rectifier, filter and a series regulator circuit. Diode CR6 prevents the inadvertent application of battery voltage of the wrong polarity. When using a battery power supply, negative polarity must always be connected to J7.

For 115 volt ac operation, jumper from Pin 1 to Pin 3 and from Pin 2 to Pin 4 on the transformer. For 230 volt ac operation, disconnect previous jumpers, and jumper Pin 2 to Pin 3. The transformer is located on board B02051200.

SECTION IV
MAINTENANCE

A. GENERAL

Since the Model 128A is all solid state and is a conservatively designed instrument, it may be expected to provide many hours of trouble free operation.

If trouble should occur, probable expected order of trouble is: incandescent panel lamp failure, development of noise in most frequently used controls, power supply diode failure, increased leakage or complete failure of transistors, increased leakage of capacitors and change in value of resistors.

To determine the operating condition of the voltmeter the General Specification Check procedure in paragraph B. should be carried out. The Alignment and Calibration procedures of paragraph C. should only be used after a major repair affecting alignment, and then only when all required test equipment is available so that the complete procedure may be carried through.

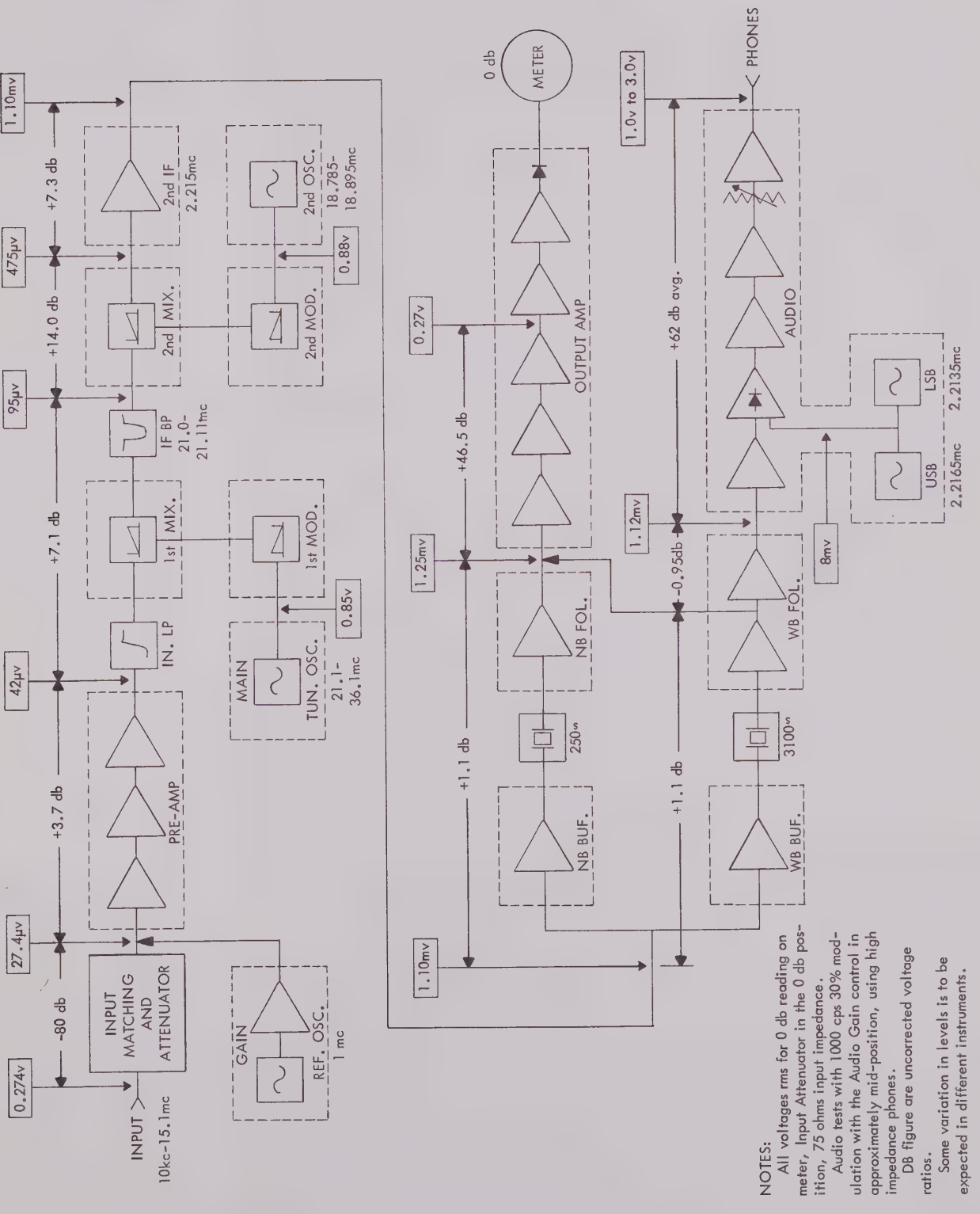
CAUTION: Since the sequence of the procedure is important in many places, a single section of the alignment should be carried out with due regard for the relationship to the preceding and following sections.

If trouble shooting becomes necessary, a good understanding of circuit operation and signal flow paths as outlined in the Theory of Operation, Section III, and the Schematic Diagram, Figure 3-5, will aid greatly in tracing the cause of the trouble.

Signal level voltages at numerous points along the signal flow path are given in the Signal Levels Block Diagram, Figure 4-1. Voltages indicate the rms signal level to be introduced at that point to obtain a 0 dB reading on the meter of the 128A instrument. The frequency of the signal will be the frequency that normally occurs at that point as indicated on the Block Diagram. Signal levels may be expected to vary somewhat in different instruments.

Wave forms, frequency and amplitude of the Frequency Lock circuits are given in Figures 4-4 and 4-7.

Locations of module and calibration adjustment points are given in Figures 4-2, 4-3, 4-5, 4-6, 4-8 and 4-9.



NOTES:
All voltages rms for 0 db reading on meter, Input Attenuator in the 0 db position, 75 ohms input impedance.
Audio tests with 1000 cps 30% modulation with the Audio Gain control in approximately mid-position, using high impedance phones.
DB figure are uncorrected voltage ratios.
Some variation in levels is to be expected in different instruments.

Figure 4-1. Signal Levels, Block Diagram

The circuit boards have a number screened on the component side. This is the same number as that which appears within the dashed-line box indicating the module on the Schematic Diagram. The name of the module is etched on the foil side of the circuit boards. This name also is the same as that appearing on the Schematic Diagram.

The following general outline of trouble tracing is suggested:

1. Make sure all cable connectors are properly connected and screwed up snugly.

2. Check power supply output voltage. It should be -16 ±0.25V DC.

3. Using a wideband oscilloscope (such as Tektronix 581) check for proper output at J8, Main Tuning Follower, and at J20, Second Oscillator. This check will localize the trouble to either of the Tuning modules or to the signal flow path modules.

4. If the output of either Tuning module is improper as to frequency, waveform or amplitude, Figure 4-4a or 4-7a, the various module circuits should be carefully checked using the waveforms of Figures 4-4 and 4-7 as a guide to proper operation.

5. If tuning and module output waveforms appear to be correct, the trouble is probably in the signal flow path modules. Refer to Figure 4-1 and introduce a signal of the proper amplitude and frequency at a point midway along the signal path. For example: a 2.215 Mc, 475 microvolt signal into the input of the second IF amplifier. (Tuning modules must be connected and operating for these tests.)

6. If the panel meter reads approximately 0 dB, select a point farther back toward the Input to introduce the next test signal.

7. If panel meter reading varies widely from 0 dB, or no reading is obtained for the test of paragraph 5 above, select a point closer to the meter and introduce the proper test signal.

8. Follow the above procedure until faulty module is bracketed between two closely spaced test points.

Note that the attenuator must not be placed in the -90 dB position for these tests. In this position an extra 10 dB gain is introduced into the Output Amplifier.

9. When the faulty module has been located, check the signal flow through that module and check individual components as necessary.

B. GENERAL SPECIFICATIONS CHECK

1. Test Equipment Required, equivalent equipment may be used:

a. RF Signal Generator, HP606A
b. Frequency Counter, HP 524C
c. 50 ohm Coaxial Termination Load, Sierra 160-1
d. AC VTVM, HP 400L
e. RF Microvoltmeter with 50 ohm probe, Millivac MV28B
f. VHF Attenuator, HP 355D
g. Audio Oscillator, HP200CD
h. 100 kc Low-Pass Filter, 600 ohms

The Model 128A being checked will be referred to as the voltmeter in the following procedure.

2. Frequency Accuracy of Lock System

a. Connect the output of the RF Signal Generator to the Frequency Counter and connect both to the input of the voltmeter.

b. Set the voltmeter Attenuator to CAL, 75 ohm/TERM, SELECTIVITY to NARROW, MAIN TUNING mode to LOCK, MAIN TUNING dial to 1 mc, locked, and the INCREMENTAL Tuning dial to 0.0 k.

c. Carefully tune the INCREMENTAL dial for maximum indication and set the cursor adjustment exactly to the 0.0 kc point on the INCREMENTAL Tuning dial. (This accurately sets the INCREMENTAL dial Tuning using the Reference Oscillator in the voltmeter.)

d. Set the MAIN TUNING to 0.1 mc locked, and the Attenuator to 0 dBm.

e. Adjust the output of the RF Signal Generator to approximately 0 dB. Very carefully tune for maximum indication on the voltmeter. Check very carefully for maximum indication. The Frequency Counter should now read within ±302 cycles of 100 kc.

f. Set the MAIN TUNING to 1.0 mc, locked. Tune the RF Signal Generator very carefully for maximum indication on the voltmeter. The Frequency Counter should read within ± (20 +300) = ±320 cycles of 1.0 mc.

g. Set the MAIN TUNING dial to 15.0 Mc, locked, and tune RF Signal Generator very carefully for maximum indication on the voltmeter, as above.

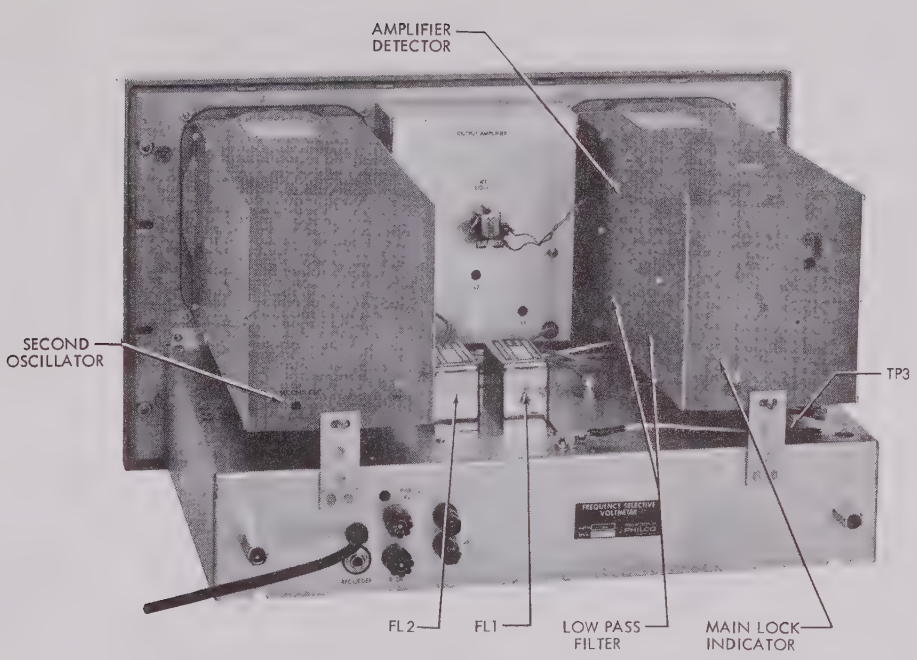


Figure 4-2. Rear View, Module Location

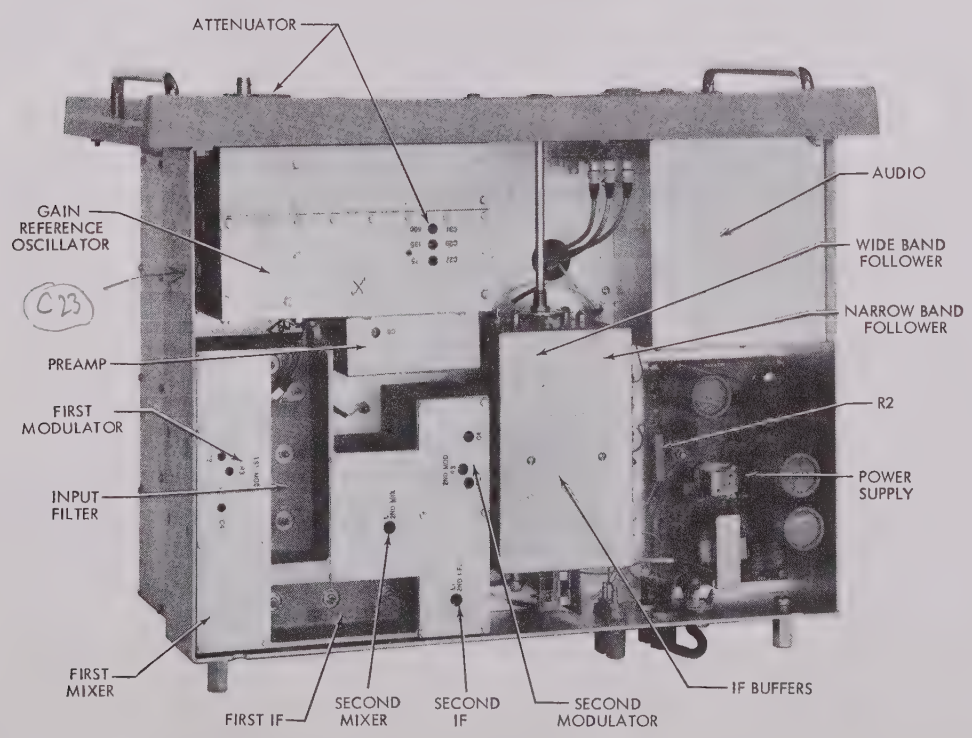


Figure 4-3. Bottom View, Module Location

The Frequency Counter should read within ± (300 + 300) = ±600 cycles of 15.0 Mc.

3. Measurement Accuracy, 0 dBm Calibration at Reference Frequency of 1 Mc.

a. Set the voltmeter Attenuator to CAL, 75 ohm/BRG, SELECTIVITY to NARROW, MAIN TUNING mode to LOCK, MAIN TUNING dial to 1.0 Mc, locked, and INCREMENTAL Tuning dial to 0.0 kc.

b. Carefully tune the INCREMENTAL Tuning dial for maximum indication on the meter and adjust the CAL control for an exact 0 dBm reading.

c. Set the voltmeter Attenuator to 0 dBm.

d. Connect the RF Signal Generator to the voltmeter using RG-58/U cable and BNC Tee connectors. Terminate the cable at the voltmeter end with the termination load and connect the ~~AC VTVM~~ B+K also to the input of the voltmeter.

e. 75 Ohm Input Impedance

(1) Set the RF Signal Generator to 1 Mc and the output to 0.274 volts as read on the ~~AC VTVM~~. B+K (The accuracy of the ~~AC VTVM~~ B+K should be 1% or better.)

(2) Carefully tune the Signal Generator for maximum indication on the voltmeter panel meter. Reading should be 0 dBm ±0.2 dB.

f. 135 Ohm Input Impedance

(1) Set voltmeter Input to 135 ohms/BRG and adjust the RF Signal Generator output to 0.367 volts as read on the ~~AC VTVM~~. B+K

(2) Carefully tune the Signal Generator for maximum indication on the voltmeter panel meter. Reading should be 0 dBm ±0.2 dB.

g. 600 Ohm Input Impedance

(1) Set the voltmeter input to 600 ohms/BRG and adjust the RF Signal Generator output to 0.775 volts as read on the ~~AC VTVM~~. B+K

(2) Carefully tune the Signal Generator for maximum indication on the voltmeter panel meter. Reading should be 0 dBm ±0.2 dB.

4. Frequency Response Referred to 1 Mc

a. Connect the RF Signal Generator to the voltmeter using RG-58A/U cable and a BNC Tee connector at the voltmeter input. Connect the RF Microvoltmeter 50 ohm probe to the Tee at the voltmeter input. The 50 ohm probe serves as the termination for the cable.

b. Set the voltmeter Input Attenuator to 0 dBm, 75 ohms/BRG, SELECTIVITY to NARROW, MAIN TUNING to 1 Mc, locked, INCREMENTAL Tuning to 0.0 kc.

c. Adjust the RF Signal Generator to 1 Mc and tune for maximum output on voltmeter panel meter. Adjust for exact 0 dB reading and note RF Microvoltmeter Reading. (The RF Microvoltmeter must be calibrated for 1% accuracy or better at the frequencies at which readings are taken.)

d. Set RF Signal Generator and voltmeter to 100 kc and adjust Signal Generator for same output as noted in c. above and note reading of voltmeter panel meter. In the same manner set to 10 Mc and note reading. It should be within ±0.2 dB of 0 dB ~~in each case~~.

e. Set to 15 Mc and ~~10 kc~~, as above, and note voltmeter readings. They should be within ±0.5 dB of 0 dB. The Audio Oscillator must be used for the 10 kc ~~setting~~.

5. Attenuator Accuracy, Referred to 0 dBm

a. Connect the RF Signal Generator to the input of the VHF Attenuator. Terminate the output of the VHF Attenuator with 50 ohms and connect to the input of the voltmeter. The termination must be at the voltmeter input.

b. Set the voltmeter Attenuator to 0 dBm, 75 ohm/BRG, SELECTIVITY to WIDE, MAIN TUNING mode to LOCK, MAIN TUNING to 1 Mc, locked, and INCREMENTAL Tuning to 0.0 kc.

c. Set the VHF Attenuator for 10 dB attenuation, set the RF Signal Generator to 1 Mc, tune for maximum output on voltmeter panel meter and adjust for exactly 0 dB reading on the voltmeter.

d. Set the VHF Attenuator for 20 dB Attenuation and set the voltmeter Attenuator to -10 dBm. Voltmeter should read 0 dBm ±0.1 dB.

e. Follow the procedure of d. above, increasing VHF Attenuator attenuation in 10 dB steps and at the same time decreasing the voltmeter attenuation in 10 dB steps until the VHF Attenuator reads 100 dB and the voltmeter is set to -90 dBm. Voltmeter should read 0 dB ±0.1 dB at each step.

f. Set the voltmeter to +10 dBm and the VHF Attenuator to 0 dB and note reading.

g. Set the voltmeter successively to +20 dBm and +30 dBm and read meter at -10 dB and -20 dB. All readings should be ±0.1 dB taking scale linearity (paragraph C.13.) into account in the -10 dB and -20 dB readings.

h. Follow the procedure of c. through g. for 100 kc, 5 Mc, 10 Mc, and 15 Mc. Reading tolerances are:

100 kc to 1 Mc, -90 dB to +30 dB, ±0.1 dB
10 kc to 5 Mc, -90 dB to +30 dB, ±0.2 dB

5 Mc to 10 Mc, -70 dB to +20 dB, ±0.2 dB
5 Mc to 10 Mc, -90 dB to +30 dB, ±0.3 dB

10 Mc to 15 Mc, -70 dB to +20 dB, ±0.3 dB
10 Mc to 15 Mc, -90 dB to +30 dB, ±0.8 dB

6. Spurious Responses

a. Set the voltmeter Attenuator to CAL, 75 ohm/BRG, SELECTIVITY to NARROW, MAIN TUNING mode to LOCK, MAIN TUNING dial to 1.0 Mc, locked, and INCREMENTAL Tuning dial to 0.0 kc. Carefully tune the INCREMENTAL Tuning dial for maximum indication on the meter and adjust the CAL control for an exact 0 dBm reading.

b. Connect the RF Signal Generator to the voltmeter with RG-58A/U cable and BNC Tee connector. Terminate the cable with 50 ohm Termination Load at the voltmeter Input.

c. Image Frequency Rejection

(1) Set the RF Signal Generator to 43.0 Mc and output to 0.274 volts.

(2) Set voltmeter Attenuator to -70 db, 75 ohm/BRG, SELECTIVITY to WIDE, MAIN TUNING to 0.8 Mc, locked. Tune Signal Generator for a response at this frequency. Maximum response should be less than 0 dB (below -70 dBm).

(3) Repeat (1) and (2) with RF Signal Generator set to 50.0 Mc and voltmeter tuned to 7.8 Mc. Meter reading should be less than 0 db (below -70 dBm).

(4) Repeat (1) and (2) with RF Signal Generator set to 57.0 Mc and voltmeter tuned to 14.8 Mc. Meter reading should be less than 0 dB (below -70 dBm).

d. Direct First IF Response

(1) Tune the RF Signal Generator to 21.0 Mc and adjust for 0.274 volts output.

(2) Set voltmeter Attenuator to -70 dBm, 75 ohm/BRG, SELECTIVITY to WIDE.

(3) Carefully tune the Signal Generator for maximum response on the meter. Fine tune with voltmeter INCREMENTAL Tuning control. Meter should read less than 0 dB (below -70 dBm).

e. Direct Second IF Response

(1) Set the voltmeter Attenuator to -80 dBm, 75 ohm/BRG, MAIN TUNING to 1.0 Mc, locked, SELECTIVITY to WIDE.

(2) Set the Signal Generator to 2.215 Mc and adjust for 0.274 volts output. Carefully tune the Signal Generator for maximum response. Voltmeter should read less than 0 dB (below -80 dBm).

f. Residual Distortion Attenuation

(1) Connect the 600 ohm, 100 kc Low-Pass Filter to the output of the Audio Oscillator. Connect the output of the filter to the input of the voltmeter.

(2) Set the voltmeter Attenuator to 0 dBm, 600 ohms/TERM, SELECTIVITY to NARROW, MAIN TUNING mode to LOCK, MAIN TUNING dial to 0.1 Mc, locked, and INCREMENTAL tuning to 0.0 kc.

(3) Set the audio oscillator to 100 kc, tune for maximum indication on the voltmeter and adjust for a 0 dB reading.

(4) Set the voltmeter Attenuator to -50 dBm and tune the voltmeter for a response at 200 kc. Response should be less than -15 dB on the meter (below -65 dBm).

(5) Tune the voltmeter for a response at 300 kc. Response should be less than -15 dB on the meter (below -65 dBm).

7. Audio Output

a. Set the RF Signal Generator to 1 Mc, modulated 30% with 1 kc, connect to the Input of the voltmeter and adjust for a 0 dB reading on the voltmeter with SELECTIVITY set to NARROW.

b. AM Check

(1) Set the AUDIO MODE switch to AM, the GAIN control full counterclockwise and plug phones (600 ohms impedance or higher) into the PHONES jack. Use lower jack for single plug.

(2) Advance GAIN control until a signal is heard at a comfortable listening level, GAIN control in the neighborhood of mid-range.

c. SSB Check

(1) Switch off the modulation in the RF Signal Generator.

(2) Set the AUDIO MODE switch to LS and then to US. A tone of approximately 1500 cycles in frequency should be heard in each position. Frequency of tone will depend on voltmeter tuning.

C. ALIGNMENT AND CALIBRATION

No change in adjustments should be made unless the required test equipment is available and complete alignment procedures may be carried out. In this procedure the instrument being aligned will be referred to as "the voltmeter".

1. Test Equipment Required (Item Listed or Equivalent)

a. RF Signal Generator, HP 606A
b. Milliammeter, HP 428B
c. DC Vacuum Tube Voltmeter, HP 412A
d. AC Vacuum Tube Voltmeter, HP 400L
e. VHF Attenuator, HP 355D
f. Frequency Counter and Converter, HP 524C and 525A
g. 50 ohm Coaxial Termination Load, Sierra Model 160-1
h. RF Microvoltmeter with High Impedance Probe, Millivac MV28B
i. RF Oscilloscope, Tektronix 581
j. Attenuator Network, Daven VT795G
k. Audio Oscillator, HP 200CD
l. Metered Variac, General Radio W5MT3A

2. Power Supply

a. Measure DC resistance to ground, TP2 to TP1. Should be no less than 60 ohms with Main Tuning Mode switch in CONT and no less than 40 ohms in LOCK.

b. Connect the voltmeter to a variable 115 volt AC source. Connect the DC VTVM to TP2, B- and TP1, ground, on the power supply circuit board. Adjust the AC source to 115 volts and switch the voltmeter on.

c. DC VTVM should read -16.0 volts. If not, adjust R2 in the power supply until a reading of -16.0 volts is obtained.

d. Remove F2 (0.3 amp fuse) and connect milliameter across fuse terminals. Full load DC current should be no more than 300 mA.

e. Vary the AC source voltage between 105V and 125V. There should be no change in the DC VTVM reading. A change would indicate voltage regulator trouble.

f. Connect the DC VTVM to the external battery input jacks, J6-J7. Short CR6 in the power supply with a clip lead and short the three relay contact springs (K1 in power supply) together. (K1 has been eliminated in later run instruments.) The DC VTVM should read -16 volts. Remove the clip lead from CR6 while leaving the relay contacts shorted and observe that voltage is removed from J6-J7. This checks proper operation of CR6 which is to prevent wrong polarity connection of an external battery supply.

3. Audio Circuits

It is necessary to remove the Audio cover shield to gain access to all adjustments on the Audio module.

a. Disconnect J23, input to IF Buffers and P18 and P10, the B- connections to the tuning oscillators.

b. Connect the Frequency Counter to the vertical amplifier output of the Oscilloscope.

c. Connect the vertical input of the Oscilloscope to the junction of C20-R28 on the Audio module and turn the Detector Mode switch to LS.

d. Adjust L3 on the Audio module for maximum indication on the Oscilloscope (approximately 1.0 volts p-p) and check that the frequency reading on the counter is 2.2135 Mc ±110 cps.

e. Connect the Oscilloscope to the junction of C26-R38 on the Audio module and turn the Detector Model switch to US.

f. Adjust L4 for maximum indication on the Oscilloscope (approximately 1.0 volts p-p) and check that the frequency reading on the counter is 2.2165 Mc ±110 cps.

g. Connect the Signal Generator to P25, (inputto the audio module) and the Oscilloscope to the base of Q2 on the Audio module. Tune the Signal Generator to 2.215 Mc and adjust modulation to 30% at 1 kc. Set RF output to approximately 1.12 mV.

h. Connect the AC VTVM to the PHONES Jack J4, turn the Audio Gain control, R39, to approximately mid-position and set AUDIO MODE switch to AM.

i. Adjust L1 for maximum indication on the AC VTVM.

j. Output voltage for each setting of the Detector Mode switch should be approximately as follows:

AM - 1.0-3.0 volts modulated
LS - 1.0-3.0 volts unmodulated
US - 1.0-3.0 volts unmodulated

k. Reconnect P25 to J25.

4. Output Amplifier

a. Connect the Signal Generator to P24 (input to the output amplifier module), tune to 2.215 Mc and set the output to approximately 500 μV.

b. Set the voltmeter front panel CAL control and R19 on the output amplifier PCB to approximately center position.

c. Set the voltmeter Attenuator switch to -90 dB, 75 ohm/TERM. Check that the relay K1 on the output amplifier PCB operates as Attenuator switch is moved from -80 dB to -90 dB position.

d. Adjust L1 and L2 in the output amplifier for maximum deflection on the voltmeter panel meter, approximately 0 dB.

e. Set the Signal Generator output for an exact 0 dB reading.

f. Switch the voltmeter Attenuator to the -80 dB position and raise the Signal Generator output 10 dB.

g. Adjust R4 on the output amplifier PCB for a 0 dB reading.

h. With R19 at approximately 4.5 dBm from high gain end and CAL Pot centered and the attenuator positioned to -90 dB, the input level from the Signal Generator should be between 100 μV and 120 μV for a 0 dB reading on the meter.

i. Reduce the Signal Generator output by 10 dB for a -10 ±0.2 dB reading on the meter.

5. Crystal Filter

a. Connect the Signal Generator to J23 (input to the IF Buffers), tune to 2.215 Mc and set output to approximately 140 μV with the voltmeter in narrow band.

b. Set the voltmeter front panel SELECTIVITY switch to WIDE and set the CAL control (or Signal Generator output) for an exact 0 dB reading on the voltmeter panel meter.

c. Turn SELECTIVITY switch back to narrow and adjust R11 on the IF Buffer PCB for a 0 dB reading. Reconnect cable to P23.

6. Second IF

a. Remove the T shaped cover from the IF casting. Set the voltmeter attenuator to -90 dBm. Tune the Signal Generator to 2.215 Mc and set the output to approximately 3.0 μV.

b. Using a 0.1 μF capacitor connect the Signal Generator to the input of the second mixer. Disconnect orange wire from feed-through insulator and connect Signal Generator to the conductor in the feed-through insulator.

c. Set the voltmeter SELECTIVITY switch to WIDE.

d. Adjust L1 in the second IF and L1 in the second mixer for maximum deflection on the voltmeter panel meter.

e. Replace IF cover and reconnect the orange wire to feed-through.

7. Basic Alignment Of Signal Path

CAUTION: No change in this adjustment should be made unless it is definitely determined that band-pass characteristic is not flat.

a. Remove the rectangular cover over the First Mixer, Modulator.

b. Connect the B- plug P18 to J18 to provide B- for the Incremental Tuning oscillator. Set Incremental Tuning dial to 0.0 position and Attenuator to -90 dBm.

c. Tune the Signal Generator to 21.1 mc using the frequency counter, set to approximately 3-10 mV output, and connect to the First Modulator output at the 220 ohm feed-through resistor R7. Set R3 in the Second Modulator to mid range.

d. Adjust L5, L6, L7 in the First IF for maximum deflection on the voltmeter panel meter, decreasing the Signal Generator output to keep the meter on scale as necessary. Signal Generator output should be approximately 2.5 μV for a 0 dB panel meter reading. Check for possible oscillation in the IF stage by disconnecting the input signal. Meter should fall to zero. Oscillation may be caused by L4 coil slug in the input LP Filter being set too far out. Replace casting cover.

e. Reconnect the B- connection P10 to the main tuning oscillator. Set the Main Tuning dial to 1.0 mc. Set the voltmeter input Attenuator to -80 dB, 75 ohm/TERM and set the bandwidth switch to narrow.

f. Tune the Signal Generator to 1 Mc, with 30%, 1 kc modulation. Set the output to approximately -80 dB and connect to the voltmeter input (terminated with 50 ohms).

g. Readjust all inductances for maximum panel meter deflection, L5, L6, L7 in the First IF, L1 in the Second Mixer, L1 in the Second IF, L1, L2 in the output amplifier.

h. Connect the AC VTVM to the phones jack J4, set Detector Mode switch to AM and tune L1 in the audio amplifier to maximum indication on the AC VTVM.

8. First Modulator

a. Correct output from and proper frequency locking of the MAIN TUNING and INCREMENTAL Tuning modules is required for the following modulator alignment procedures. The appropriate parts of paragraphs 11. and 12. should be carried out at this point if necessary.

b. Set the voltmeter Attenuator to -20 dB, 75 ohm/TERM and the SELECTIVITY switch to NARROW. Set the MAIN TUNING dial to 0.0 Mc and tune the INCRE-

MENTAL Tuning oscillator to 10 kc. Voltmeter in locked condition.

d. Set C2, C4 in the First Modulator to mid range.

e. Disconnect preamplifier cable from J32.

f. Tune the INCREMENTAL oscillator toward 0 kc and adjust R3, C2, C4 in the First Modulator to minimize meter reading while tuning the incremental oscillator further toward 0, until an adjustment minimum is reached. Reconnect the preamplifier cable to J32. A 3 kc setting on the incremental oscillator should cause a meter reading of less than -20 dB with attenuator in the -90 dB, 75 ohm/TERM position.

9. Second Modulator

a. The following procedure requires that the voltmeter be adjusted for true gain. To insure this requirement perform the steps in paragraph 14. a.- d.

b. Set the voltmeter SELECTIVITY switch to NARROW and the Main Tuning dial to 0.1 Mc. Set the input Attenuator to -90 dB, 75 ohm/TERM.

c. Tune the Incremental Tuning oscillator slowly from 0 to 100 kc. Note the residual noise level on the output meter. Should be 1.0 microvolt or less on the 30 microvolt scale.

d. Check for spurious response as the Incremental Tuning oscillator is tuned to 100 kc. Advance R3 in the First Modulator two complete turns. This should bring the spurious response up to approximately -80 dB.

e. Set C10 and C14 in the Incremental Reference Oscillator and Mixer to midrange. Starting with R7, alternately adjust R7, C10 and C14 for the lowest possible level of the spurious response noted in d. above.

f. Rebalance the First Modulator with R3, paragraph 8. above.

g. Retune as in 9.b. above. With Incremental Tuning oscillator set to 100 kc the spurious response should be -110 dB down or greater, or 1.0 microvolt above the residual noise noted in c. above.

h. Set the Main Tuning oscillator to 0.3 Mc. Set C2 and C4 in the Second Modulator to midrange. Tune the Incremental Tuning oscillator to 23, 54, 78.5

and 98.6 kc. Check for spurious responses. Alternately adjust R3, C2 and C4 in the Second Modulator to bring the spurious responses to below -105 dB.

i. Set the Main Tuning oscillator to 0.1 Mc and check for a spurious response between 53 and 57 kc with the Incremental Tuning oscillator. Tune L2 in Incremental Reference oscillator slightly to minimize this spurious response.

j. Tune the Incremental Tuning oscillator slowly from 0 to 100 kc. Check that all spurious responses are below -105 dB except 100 kc which must be below 110 dB, or 1.0 microvolt above residual noise level noted in c. above.

10. Input Filter

a. Set the 4 coil slugs of the input LP Filter 1/16" out from fully in.

b. Tune the Signal Generator to 7.8 Mc, set output to -91.75 dB, terminate with 50Ω coaxial termination load at the voltmeter end of the cable and connect to the voltmeter input.

c. Set the voltmeter Attenuator to -90 dB, 75 ohm/BRG and tune in the 7.8 Mc signal. Adjust the CAL control for a panel meter reading of 0 dB.

NOTE: This adjustment may be done in "WIDE BAND" if drift is excessive.

d. Tune the Signal Generator to approximately 21.1 Mc raise generator level 70 dB, and adjust L2 in the input Low-Pass Filter for minimum reading on the voltmeter.

e. Adjust L4 in the input Low-Pass Filter to obtain a level of -71 dB difference between the voltmeter and the Signal Generator. Recheck and if necessary retune L2.

f. Tune the Signal Generator to 15.1 Mc and adjust L3 in the input Low-Pass Filter for maximum reading on the voltmeter.

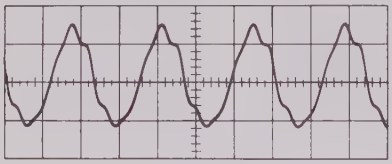
NOTE: It may be necessary to increase the Signal Generator output for this adjustment.

g. Recheck the frequencies of 21.1 Mc and 7.8 Mc for a -71 dB difference. Readjustment of L2 and L4 may be required.

11. Main Tuning Oscillator, Locking and Tracking

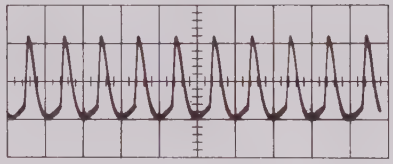
For module location and waveforms refer to Figures 4-4, 4-6 and 4-7.

Amplitude Level Variations Of As Much As ±10% May Be Observed In Different Instruments



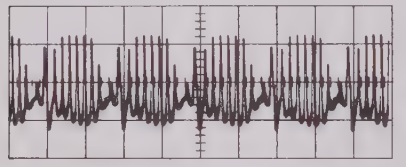
Vert: 1 V/cm
Hor: 20 nsec/cm
(581 Oscilloscope)

a. Main Tuning Oscillator output, capacitor plates fully meshed. Across 150 ohm dummy load connected to output of Main Tuning Follower output J8.



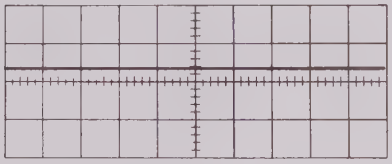
Vert: 1 V/cm
Hor: 10 usec/cm

b. Main Tuning Amplifier Detector output, collector of Q3. Locked waveform.



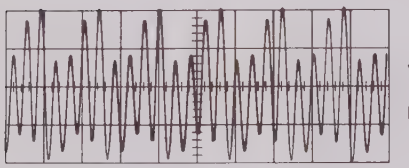
Vert: 1 V/cm
Hor: 50 usec/cm

c. Main Tuning Amplifier Detector output, collector of Q3. Unlocked waveform.



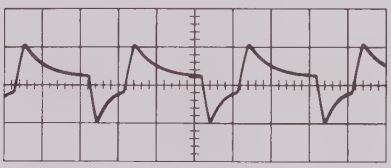
Vert: 2 V/cm
Hor: 50 usec/cm

d. 50 KC Low-Pass Filter output, junction of L1, C1, C2, R2. Locked waveform.



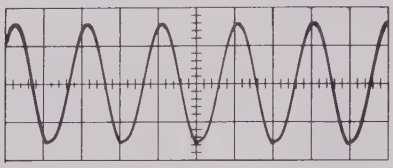
Vert: 2 V/cm
Hor: 50 usec/cm

e. 50 KC Low-Pass Filter output, junction of L1, C1, C2, R2. Unlocked waveform.



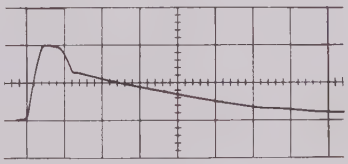
Vert: 2 V/cm
Hor: 10 usec/cm

f. Main Lock Indicator, junction of R5, R7, C4. Unlocked waveform.



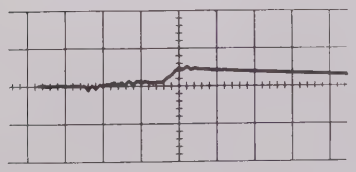
Vert: 1 V/cm
Hor: 5 usec/cm

g. 100 KC Oscillator and Harmonic Generator, oscillator output, junction of C5, C6, C7.



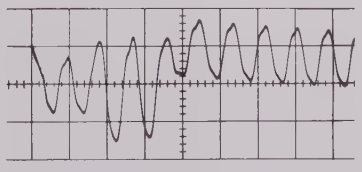
Vert: 0.5V/cm
Hor: 0.1 usec/cm
(581 Oscilloscope)

h. 100 KC pulse input to Main Tuning Mixer.



Vert: 0.1V/cm
Hor: 0.05 usec/cm
(581 Oscilloscope)

i. Main Tuning Mixer Output, Main Tuning Output disabled.



Vert: 0.1V/cm
Hor: 0.05 usec/cm
(581 Oscilloscope)

j. Main Tuning Mixer output. Arm of R10.

Figure 4-4. Main Tuning Module, Typical Waveforms

a. Adjustments, Main Tuning Oscillator Locking

(1) Attach the probe of the RF Oscilloscope to J8. With plates of the Main Tuning capacitor fully meshed, frequency about 21 Mc, the voltage should be 2.5 volts p-p. Set Figure 4-4a.

(2) Set Main Tuning Model to CONT. Set Cursor Index to midrange.

(3) Connect the Frequency Counter to J2.

(4) Set the Tuning dial to 0.0 Mc and check that tuning capacitor is 1/16" from full mesh.

(5) Adjust L1 on the Main Tuning oscillator until the counter reads approximately 21.1 Mc. (Tuning dial at 0.0 Mc.)

(6) Rotate the tuning dial to 15.0 Mc and adjust C8 until the counter reads approximately 36.1 Mc.

(7) Repeat steps (5) and (6) until counter readings are within ±10 kc.

(8) Set Main Tuning Mode switch to Lock.

(9) Attach probe of Oscilloscope to terminal 1 of T1 in the Main Tuning Mixer and check the 100 kc positive-going pulse. See Figure 4-4h. If no pulse is present, adjust L1 in the 100 kc oscillator until a pulse of maximum amplitude is obtained.

(10) Switch power supply off and on several times to check for reliable starting of the oscillator. Slight readjustment of L1 may be necessary for reliable operation.

(11) Set the RF Oscilloscope as follows:

Vertical:	0.01 V/cm/AC
Horizontal:	0.05 μsec/cm
Sync:	EXT (+) AC

Use 10x probes for both Vertical and Sync. Calibrate the vertical channel and be sure the vertical probe is properly compensated. Use shortest possible ground leads and connect both ground leads to the same spot on the casting.

(12) Connect the Vertical probe to C9 at the output of the Main Tuning Mixer. Connect the Sync probe to the junction of R14 and the emitter of Q4

in the 100 kc Oscillator and Harmonic Generator. Adjust the Oscilloscope for a stable display.

(13) Set C3 in the Main Tuning Mixer to mid-range. Disable the Main Tuning Oscillator by holding a finger across the Main Tuning trimmer capacitor, C8.

(14) Adjust R10 in the Main Tuning Mixer until the top of the first pulse in the Oscilloscope display is parallel to the horizontal baseline, disregarding the small ripple present on the pulse. The top of the pulse may be either above or below the baseline, but the height above or below should not exceed 0.3 cm. The important characteristic is that the top of the pulse be horizontal, that is, parallel to the baseline. See Fig. 4-4 i.

(15) Adjust the Oscilloscope display position so that the baseline to the left of the first pulse is exactly on a major graticule division. Adjust C8 in the Main Tuning Mixer until the second pulse is 0.5 cm high in the positive direction. Remove the finger from the trimmer capacitor in the Main Tuning Oscillator. See Fig. 4-4-j. Disconnect Sync probe.

(16) Connect the Vertical probe of the Oscilloscope to TP6, at the rear of the module. Set the Vertical sensitivity to 0.2V/cm, DC. Observe the locking action at 10 Mc. Locking is indicated by a DC trace, Figure 4-4d and the unlocked condition by an AC waveform, Figure 4-4e. If instability, AC or double lock points are observed, decrease the capacity of C3 in the Main Tuning Mixer until they all disappear. If these conditions are not eliminated at the minimum setting of C3, the Amplifier Detector has too much gain and one or more of the transistors on that board should be replaced. If no instability or double locking occurs at the mid-range setting of C3, increase the capacity until instability occurs, then back off until stable operation is restored. If C3 must be changed appreciably the Main Tuning Mixer must be reset, steps (14) and (15).

(17) Tune the Main Tuning dial over the frequency range and at each lock point make sure AC does not appear on the trace until the out-of-lock condition occurs.

(18) Fasten the side panels securely to the module. Connect the Frequency Counter to J2. Tune the Frequency Counter Converter to 36.1 Mc. Set the voltmeter Main Tuning Oscillator dial to the locked frequency position closest to the 15.0 Mc dial mark. Adjust C3 in the 100 kc Oscillator and Harmonic Generator until the counter reads 36.1 Mc ±20 cps.

(19) Disconnect P8 from J8 and connect a 100 ohm dummy load to J8. Connect the High Impedance probe of the RF Microvoltmeter across the 100 ohm dummy load. Tune over the full range of the Main Tuning Oscillator. Output at J8 should be 0.9V ±15%. Disconnect dummy load and reconnect P8.

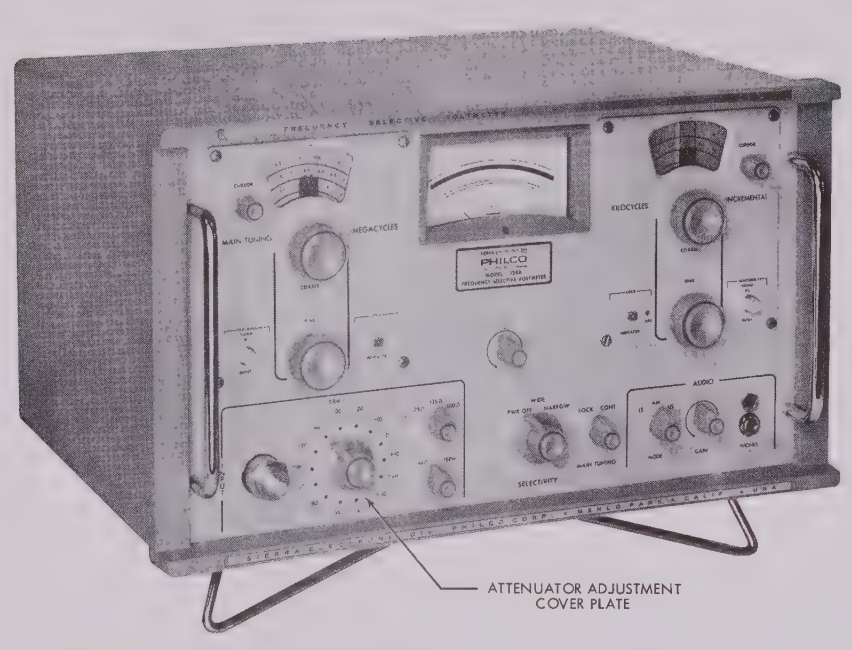


Figure 4-5. Front View, Module Location

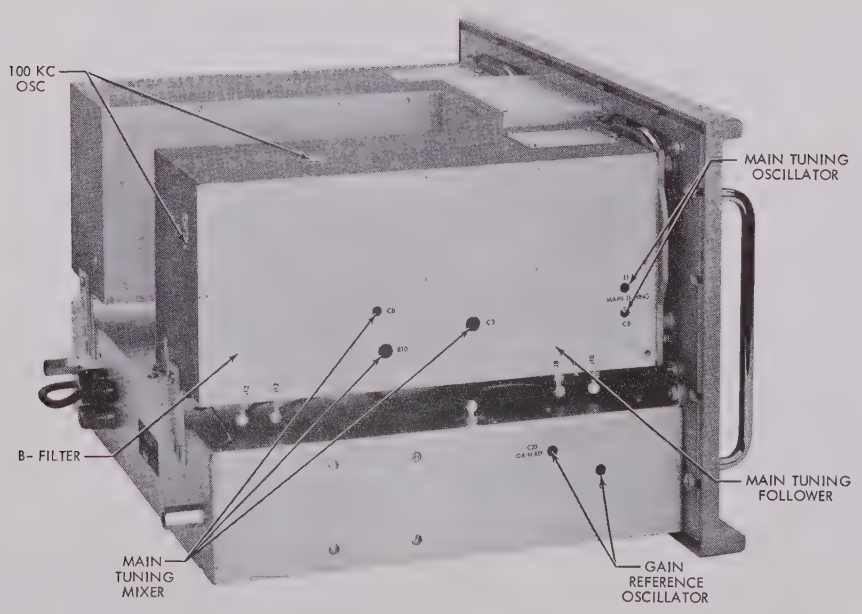


Figure 4-6. Left Side View, Module Location

b. Main Tuning Oscillator Tracking

(1) Connect the Frequency Counter to J2 on the Main Tuning oscillator. Turn the Main Tuning mode switch to CONT.

(2) Check that the end frequencies are within ±10 kc of 21.1 and 36.1 Mc (0.0 and 15.0 on the dial). If not refer to paragraphs a. (5)-(7) above.

(3) Turn the MAIN Tuning mode switch to LOCK. Check the frequency locking at each megacycle mark and note the tuning dial settings. If all frequencies read either high or low on the dial, shift the dial disc by loosening its set screw to achieve an even reading distribution. Tighten setscrew after dial disc is shifted. Recheck (2) and readjust the end frequencies according to paragraphs a. (5)-(7) if necessary. (Adjustments of this and following step necessary only after major parts replacement or major overhaul.)

(4) Starting at the high end check in 100 kc steps that frequency locking occurs at each step within the width of the indicator slot. Adjust misalignments by slightly bending the outside capacitor plates. Access to the plates is through a hole in the top of the casting. (This step should be necessary only after major parts replacement or major overhaul.)

(5) Set the dial to exactly 1 Mc and note counter reading. Switch the Main Tuning mode switch to CONT. Adjust R2 on the Main Tuning switch until the counter reading in CONT position is within ±1 kc of the counter reading in LOCK position.

12. Incremental Tuning Oscillator, Locking and Tracking

a. Preliminary Checks and Adjustments

(1) Connect a 100 ohm load to J20 on the Second Oscillator and attach the probe of the Oscilloscope to J20. The frequency should be about 19 Mc and the voltage 2.1 volts p-p ±0.3V.

(2) Attach the Oscilloscope probe to terminal 1 of T1 in the Incremental Reference Oscillator and Mixer and check for approximately 4 volts p-p signal. See Figure 4-7b. If no signal is present, adjust L2 and C3 of the crystal oscillator circuit until the signal appears and adjust for maximum amplitude.

(3) Switch the power supply off and on several times to check for reliable starting of the oscillator. Slight readjustment of L2 may be necessary to assure proper operation.

(4) Attach the DC VTVM to the junction of C12 and R4 in the Second Oscillator. Adjust the LOCK ADJ control, R1, on the front panel until the voltage is -13.8 volts.

(5) With CURSOR control set the cursor line to the middle of the dot at the top of the bezel.

(6) Set the Incremental Tuning dial to 100 kc and check that the tuning capacitor is 11/32" from full mesh.

(7) Connect Frequency Counter to TRACKING SIGNAL jack on the front panel.

(8) Set the Tuning capacitor to read 100 kc on the dial. Adjust L1 in the Incremental Tuning Oscillator until the counter reads 200 kc ±100 cps.

(9) Set the Tuning capacitor to read 0 kc on the dial. Adjust C6 in the Incremental Tuning oscillator until the counter reads 300 kc ±100 cps.

(10) Set R7 and C10 in the Incremental Reference Oscillator and Mixer to mid-range. Set C14 to minimum (CCW).

(11) Connect the Frequency Counter through a 3300 ohm resistor to terminal 1 of transformer T1 in the Incremental Reference Oscillator and Mixer. Adjust C3 in the Incremental Reference Oscillator and Mixer until the counter reads 18.585 Mc ±10 cps. Disconnect counter.

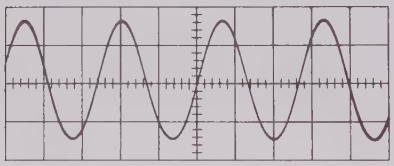
b. Locking Adjustment

(1) Attach the oscilloscope probe to the output of the First L.F. Amplifier and turn the Tuning dial control until the tuning capacitor plates are at full mesh. Adjust R1 in the First L.F. Amplifier for 5.7 volts p-p. Tune Incremental Tuning dial over the range. Total variation in output variation should not exceed 10%. If it does, select Q1 in Incremental Tuning oscillator.

(2) Attach the oscilloscope probe to the output of the Second L.F. Amplifier and fully open the Tuning capacitor plates. Adjust R3 in the Second L.F. Amplifier for 1.6 ±0.1 volts p-p.

(3) Connect the DC VTVM to TP7. Adjust L1 in the Second Oscillator for a reading of 0.0 volts dc ±0.1 volts with tuning set at -10 kc. DC excursion voltage over frequency range should be 4 ±1 volt.

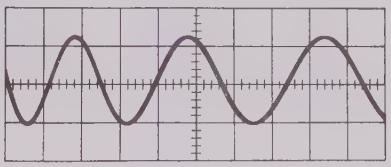
Amplitude Level Variations Of As Much As ±10% May Be Observed In Different Instruments



Vert: 2 V/cm

Hor: 20 nsec/cm

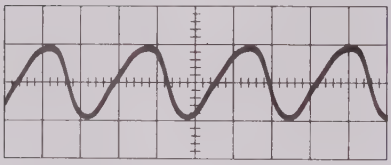
a. Second Oscillator output at J20.



Vert: 2 V/cm

Hor: 20 nsec/cm

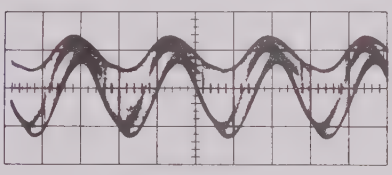
b. Incremental Reference Oscillator and Mixer, Crystal Oscillator output, terminal 2 of transformer T1. Second Oscillator disconnected.



Vert: 2 V/cm

Hor: 20 nsec/cm

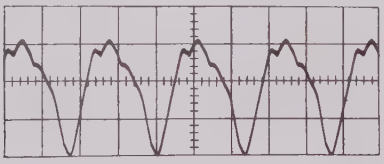
c. Incremental Reference Oscillator and Mixer, Second Oscillator input, terminal 4 of transformer T1.



Vert: 0.1 V/cm

Hor: 2 usec/cm

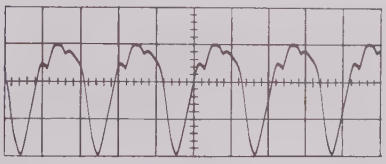
d. Incremental Reference Oscillator and Mixer output, arm of R7. Incremental Tuning Oscillator capacitor plates meshed.



Vert: 0.5 V/cm

Hor: 2 usec/cm

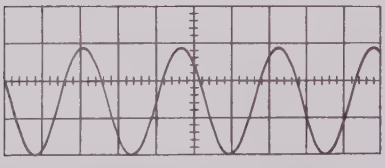
e. Second L.F. Amplifier output. Terminal 1 of transformer T2 in Phase Discriminator. Incremental Tuning Oscillator capacitor plates meshed.



Vert: 0.5 V/cm

Hor: 1 usec/cm

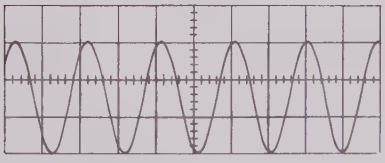
f. Second L.F. Amplifier output. Terminal 1 of transformer T2 in Phase Discriminator. Incremental Tuning Oscillator capacitor plates open.



Vert: 2 V/cm

Hor: 2 usec/cm

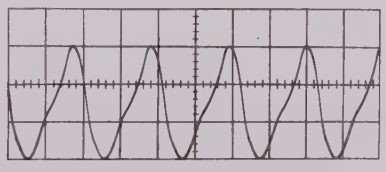
g. First L.F. Amplifier output. Terminal 3 of transformer T1 in Phase Discriminator. Incremental Tuning Oscillator capacitor plates meshed.



Vert: 2 V/cm

Hor: 2 usec/cm

h. First L.F. Amplifier output. Terminal 3 of transformer T1 in Phase Discriminator. Incremental Tuning Oscillator capacitor plates open.



Vert: 2 V/cm

Hor: 2 usec/cm

i. Phase Discriminator output, junction of CR1 and R6. Incremental Tuning Oscillator capacitor plates meshed.

Figure 4-7. Incremental Tuning Module, Typical Waveforms

(4) With oscilloscope still connected to the output of the Second L.F. Amplifier, adjust R5 in the Phase Discriminator for a stable, symmectrical waveform throughout the range of the Tuning capacitor. See Figure 4-7f. Readjust R3 in the Second L.F. Amplifier, if necessary, to maintain 1.6 ±0.1 volts p-p output.

(5) Check for optimum setting of R5 in the Phase Discriminator by removing power from the module for 5 seconds, then restoring power. The module should relock within 1 second after power turn-on, over the full range of the Tuning capacitor. Fasten side panels securely to the module. Repeat Section 12.b.3.

c. Tracking Adjustment

(1) Rotate the Incremental Tuning capacitor over its range and check that the Lock Indicator light stays on. A slight readjustment (CCW0 of L1 in the Second Oscillator may be necessary if the light goes out at any point.

(2) Connect the AC VTVM to the Tracking Signal input jack, J3, on the Incremental Tuning dial plate, and connect the Frequency Counter to the AC VTVM amplifier output. If the Frequency Counter has sufficient sensitivity, the AC VTVM amplifier may be omitted.

(3) Set the Tuning capacitor to read 100 kc on the Incremental Tuning dial with cursor set to reference dot on top of dial bezel. Adjust L1 in the Incremental Tuning oscillator until the counter reads 200 kc.

(4) Set the Incremental Tuning capacitor to read 0 on the Tuning dial. Adjust C6 in the Incremental Tuning oscillator until the counter reads 300 kc.

(5) Repeat steps (3) and (4) until both frequencies are within ±20 cps.

(6) Starting at the high end, check in 10 kc steps that the 300 kc and 200 kc readings (0 kc and 100 kc dial settings) are within ±20 cps and all other readings are within ±200 cps of each corresponding dial setting. Each setting should be rocked into place with back and forward movements of the tuning knob to eliminate backlash irregularities.

(7) Unless misalignment is serious the following two steps should be omitted.

(a) Note the tuning dial settings at all frequency points. If all frequencies read either high or low on the dial, shift the capacitor by loosening the set screw in the coupling to achieve even reading distribution. Recheck and readjust as necessary the settings of (3), (4), (5), and (6).

(b) Adjust incorrect readings by slightly bending the Tuning capacitor plates. Access to the plates is through the top hole of the casting.

13. Meter Linearity

a. Turn off power to the voltmeter and check that the mechanical zero adjustment of the meter is set properly. Switch voltmeter back on after checking zero adjustment.

b. Connect the Audio Oscillator to the input of the Attenuation Network and the output of the Attenuation Network to the input of the Voltmeter. Set Attenuator Network for 12 dB attenuation. Set the voltmeter Attenuator to -10 dB, 600 ohms/TERM, and SELECTIVITY switch to NARROW.

c. Set the Audio Oscillator to 100 kc, tune in the signal with the voltmeter and set Audio Oscillator for a 0 dB reading on the voltmeter panel meter.

d. Adjust the Attenuation Network for voltmeter panel meter readings of +2, +1, -1, -2, -3, -4, -5, -6, -7, -8, -9, -10, -15 and -20 dB. Note difference between meter reading and the value of the attenuation switched out or in. Limit: +2 to -10 dB ±0.2 dB, -15 dB ±0.5 dB, -20 dB ±1.0 dB. R1 in series with Recorder Output jack may be selected to obtain best linearity. Value of R1 should not exceed 15K ohms.

14. Attenuator Calibration and Gain Reference Oscillator Adjustment

a. Connect the Signal Generator to the VHF Attenuator and connect the AC VTVM to the Signal Generator output. Connect the VHF Attenuator to the voltmeter and terminate the voltmeter input with a 50 ohm coaxial termination load.

b. Switch the VHF Attenuator to the 100 dB position. Set the Signal Generator to 1 Mc and adjust the output to read 0.866 volts on the AC VTVM. Set the voltmeter Attenuator to -90 dB, 75 ohm/BRG and the SELECTIVITY switch to Narrow. Keep the reading on AC VTVM constant at 0.866V for all measurements c. thru k. Keep signal centered in narrow band filter.

c. Tune the voltmeter to 1 Mc and adjust the CAL control to midrange. Set R19 in the Output Amplifier for a voltmeter panel meter reading of 0 dB.

d. Switch the voltmeter Attenuator to -80 dB, the VHF Attenuator to the 90 dB position and check that the panel meter again reads 0 dB. If it does not, readjust R4 in the Output Amplifier for a 0 dB reading.

e. Set voltmeter Impedance Switch to 135 ohm/BRG. Adjust C29 to reduce reference reading (-80 dB) by 2.56 dB to -82.56 dB.

f. Set voltmeter Impedance switch to 600 ohm/BRG. Adjust C31 to reduce reference reading (-80 dB) by 9.04 dB to -89.04 dB.

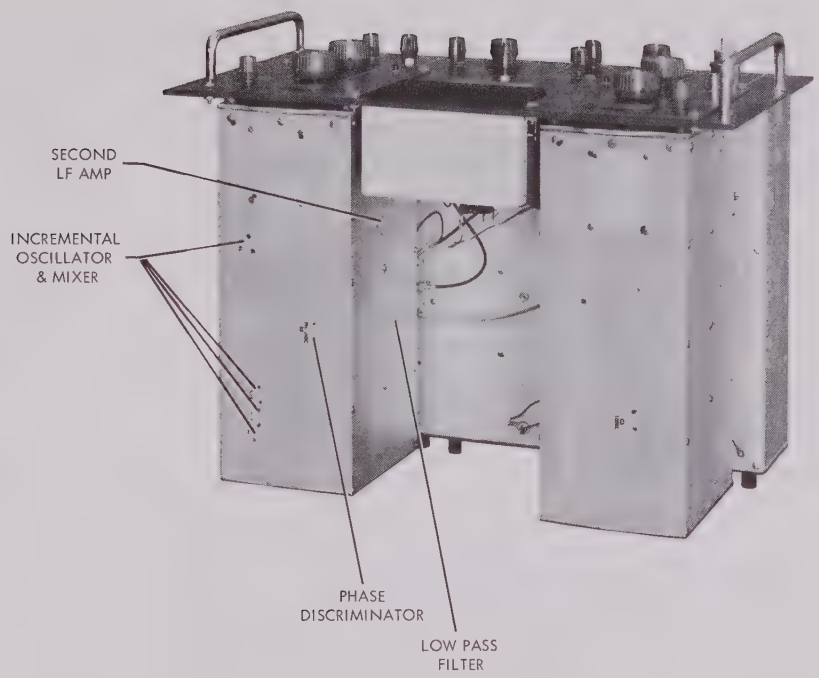


Figure 4-8. Top View, Module Location

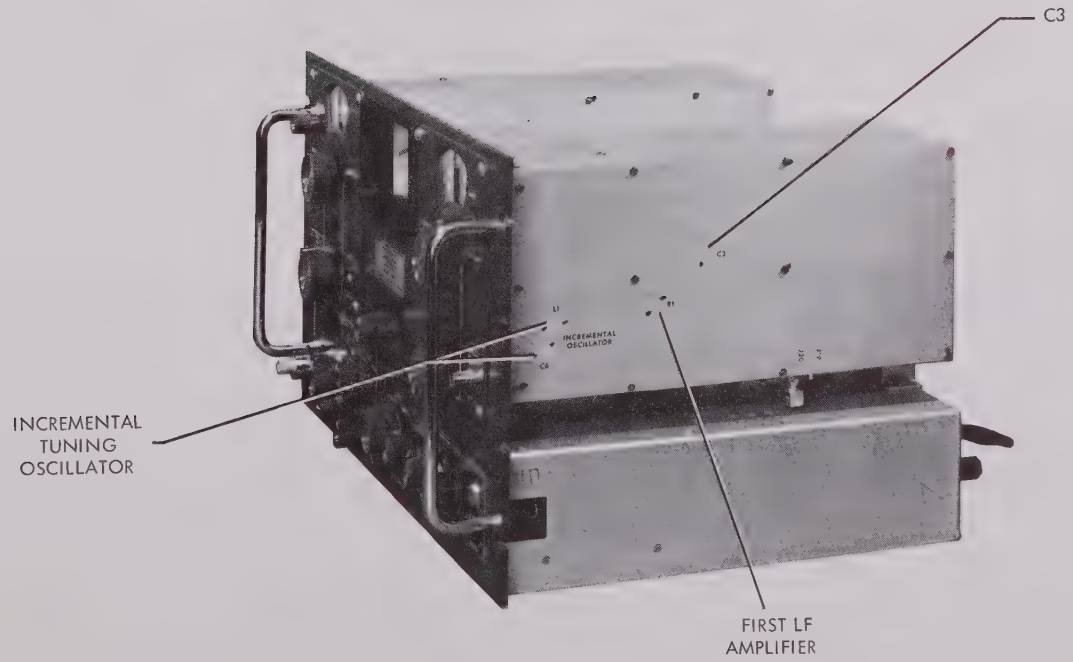


Figure 4-9. Right Side View, Module Location

g. Set the voltmeter Attenuator to 0 dB position. Set the voltmeter Impedance switch to 135 ohm/BRG. Increase the VHF Attenuator output by 80 dB to the 0 dB position. Adjust the 0 dB Attenuator trimmer to read 2.56 dB below Reference as in paragraph 14.e. (Access to the Attenuator trimmer capacitors is obtained by removing the cover plate under the Attenuator knob. The plate is held by two screws which are accessible when the Attenuator knob is removed. Each trimmer is located under the corresponding panel dB marking.)

h. Switch the voltmeter Impedance switch to 75 ohm/BRG. Adjust C27 to obtain the exact 0 dB reference reading.

i. Switch the Attenuator to CAL and tune the voltmeter for a maximum meter indication of the internal 1 Mc calibration signal. Adjust C23 in the Attenuator for an exact 0 dB meter reading.

j. Switch the VHF Attenuator to 80 dB and the voltmeter Attenuator to -70 dB, 75 ohm/BRG. Adjust the -70 dB attenuator trimmer for a 0 dB meter reading.

k. Proceed for all Attenuator steps, simultaneously decreasing the VHF Attenuator and the voltmeter Attenuator positions by 10 dB and adjust each attenuator trimmer for a 0 dB meter reading to and including the +10 dB position.

l. Connect the Audio Oscillator and the AC VTVM to the input of the Attenuator Network. Connect the output of the Attenuator Network to the voltmeter input with a 600 ohm external terminating resistor (metal film type). Set the voltmeter Attenuator to 0 dB, 75 ohm/BRG and SELECTIVITY switch to NARROW.

m. Set the Attenuator Network for 20 dB attenuation. Set the Audio Oscillator to 100 kc and adjust the output to read exactly 8.66 volts on the AC VTVM. Keep this level constant for all the measurements of paragraphs n. through p.

n. Tune the voltmeter to read maximum at 100 kc and adjust the CAL control for an exact 0 dB reading on the panel meter.

o. Switch the voltmeter Attenuator to +10 dB and the Attenuator Network to 10 dB. Check that the voltmeter reading in this position is the same as the reading obtained at 1 Mc in k. above.

p. Switch the voltmeter Attenuator to +20 dB and +30 dB and the Attenuator Network to 0 dB and adjust the voltmeter Attenuator trimmers for a 0 dB reading on the meter at +20 dB, -10 dB reading at +30 dB, taking meter linearity into account.

15. 110 kc Band-Pass First IF

CAUTION: No change in this adjustment should be made unless it is definitely determined that the band-pass characteristic is not maximally flat.

a. With MAIN TUNING Control set to 1.0 Mc, INCREMENTAL Control set to 0.0 and MAIN TUNING switch to CONT. position, tune Inductors L5, L6 and L7 on the First IF board for a peak on the panel meter.

NOTE: Inductors L5 and L7 tune out, and Inductor L6 usually tunes in.

b. Set DBM VOLTS control to 0 dBm, and tune CAL control for a 0 dB indication on the panel meter.

c. Tune to 0.9 mc with MAIN TUNING Control. Tune to 100 kc with INCREMENTAL Control.

d. Tune Inductor L5 for equal indication (±0.1 dB) at 1.0, 0 and at 0.9 and 100 on panel meter.

e. Tune INCREMENTAL Control to 50 kc, and retune MAIN TUNING Control to peak the panel meter.

f. Adjust Inductor L6 to halve the error on the panel meter.

g. Recheck at 0 and 100 kc points. Very minutely, adjust Inductor L7 to equalize indications.

h. Repeat steps b through f until all readings are within 0.1 dB of each other. Do not adjust any inductor more than 1/16 turn henceforth.

i. Check level readings at 10 kc intervals. All readings shall be within 0.1 dB of 0.0 dB.

16. Frequency Response Check

a. Connect the RF Signal Generator and the RF Microvoltmeter to the input of the voltmeter. The 50 ohm probe of the Microvoltmeter serves as the termination for the connecting cable. The RF Microvoltmeter connection must be at the voltmeter input. (The frequency response accuracy of the RF Microvoltmeter should be 1% or better over the frequency range used.)

b. Set the voltmeter Attenuator to 0 dB, 75 ohm/BRG, SENSITIVITY to NARROW, MAIN TUNING mode to LOCK, MAIN TUNING dial to 1.0 locked and

INCREMENTAL Tuning dial to 0.0 kc.

c. Tune the RF Signal Generator for a maximum indication on the voltmeter at 1 Mc and set for an exact 0 dB reading. Note the reading of the RF Microvoltmeter and adjust the RF Signal Generator to this reading at each frequency setting in the following procedure.

d. Note the reading of the voltmeter panel meter at 10 kc, 100 kc, 1 Mc, 5 Mc, 10 Mc, 13 Mc, and 15 Mc. The Audio Oscillator may be used in place of the Signal Generator for the 10 kc reading.

e. Adjust C8 and L3 in the Preamplifier, if necessary, to bring this reading within the limits given below. Best flatness generally results if C8 is set for +0.1 dB at 10 Mc, L3 for +0.1 dB at 15 Mc.

Limits for d. and e. are:

100 kc to 10 Mc ±0.2 dB
10 kc to 15 Mc ±0.5 dB

17. 0 dB Calibration

a. Connect the RF Signal Generator to the voltmeter and terminate cable with 50 ohms at the voltmeter Input. Connect the AC VTVM also across the voltmeter Input.

b. Set the voltmeter Attenuator to 0 dBm, 75 ohm/BRG, SELECTIVITY to NARROW, MAIN TUNING mode to LOCK, MAIN TUNING dial to 1.0 Mc, locked, and INCREMENTAL Tuning to 0.0 kc.

c. Carefully tune the RF Signal Generator for maximum indication of the voltmeter and set the output to exactly 0.274 volts as read on the AC VTVM. (The AC VTVM accuracy must be 1% or better.)

d. Set the voltmeter CAL control for a reading of exactly 0 dB.

e. Switch the voltmeter Attenuator to CAL and tune the INCREMENTAL dial for maximum indication. Reading should be 0 dB. If not, reset C23 in the Attenuator for 0 dB and repeat c., d., and e.

f. Set the voltmeter Attenuator to 0 dBm, 135 ohm/BRG, set the output of the RF Signal Generator to exactly 0.367 volts as read on the AC VTVM, and carefully tune the INCREMENTAL dial for maximum indication. The voltmeter reading should be 0 dB ±0.1 dB. If limit is exceeded readjust C29 in the Attenuator.

g. Set the voltmeter Impedance Selector to 600 ohms/BRG, set the output of the RF Signal Generator to exactly 0.775 volts as read on the AC VTVM and tune INCREMENTAL dial for maximum indication. The voltmeter reading should be 0 dB ±0.1 dB. If limit is exceeded readjust C31 in the Attenuator.

h. If more than a slight readjustment of C20 and C31 is required, repeat the procedure of paragraph 14.a. through p. and repeat a. through g. above.

18. Final Check

a. Carry out the complete procedure of paragraph B. General Specifications check.

19. Tracking With Model 351A Signal Generator

a. The following tracking procedure assumes that the Model 128A is properly aligned, with the Gain Reference and Local Oscillator frequencies within the required tolerances.

(1) Set the Model 128A Attenuator to CAL, 75 ohms/TERM, SELECTIVITY to NARROW, MAIN TUNING mode to LOCK, MAIN TUNING dial to 1.0 Mc, locked, and tune the INCREMENTAL tuning dial for the precise maximum meter reading. Set the CAL control for an exact 0 dB reading.

(2) Connect one of the 93 ohm (RG-62/U) cables provided between the TRACKING SIGNAL KC connectors, J3, on the Model 128A Voltmeter and the Model 351A Signal Generator INCREMENTAL Tuning panels. This connection disconnects the second local oscillator of the 128A and injects the second local oscillator frequency of the Model 351A in its place. The LOCK indicator lamp on the INCREMENTAL Tuning panel of the Model 128A may go out momentarily, but should come back on within a fraction of a second. If it does not, the ADJ control, R2 on the INCREMENTAL Tuning panel of the Model 351A must be adjusted until the lamp does come on. R2 is a 26 turn potentiometer.) Check at every 20 kc point over the full range of the Model 351A INCREMENTAL Tuning dial that the indicator lamp stays on. If necessary, readjust R2 until it does.

(3) Set the Model 351A INCREMENTAL Tuning dial to approximately 0 kc and tune very carefully for an exact maximum reading on the Model 128A meter. This reading should be exactly 0 dBm as set in (1) above. Set the Model 351A CURSOR to 0 kc on the INCREMENTAL Tuning dial.

(4) Set the Model 351A MAIN TUNING dial to 1.0 Mc, locked.

SECTION V
REPLACEABLE PARTS LIST

PARTS REPLACEMENT

Standard components have been used in this instrument whenever possible. Both standard and special components may be ordered direct from the factory.

When ordering parts always include:

1. Sierra Stock Number.
2. Circuit Reference and Commercial Description.
3. Name, Model and Serial Number of the instrument.

Parts for this instrument, or further service information may be obtained from:

SIERRA ELECTRONIC OPERATION
Philco-Ford Corporation
3885 Bohannon Drive
Menlo Park, California 94025

Telephone (415) 322-7222
TWX 910-373-1282

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REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	CHASSIS-PANEL, A02390500				
C1	CAPACITOR, Feed Thru, 1,000 pF, 500V	902640102	Erie	1201-052	4
C2	Same as C1				
C3	Same as C1				
C4	Not Used				
C5	Same as C1				
F1	FUSE, .25A, 3AG, Slo-Blo	913200033	Littelfuse	313.300	1
	For 230 volt operation use: FUSE, 1/8A, 3AG, Slo-Blo, 250V				
F2	FUSE, 3/10A, 250V, 3AG	913200032	Littelfuse	312.250	1
J1B	CONNECTOR, Adapter to BNC for 874-PRLT	914600089	General Radio	874-QBJL	1
	CONNECTOR, 90 Adapter	914600101	Amp	329097	11
J5	JACK, Phone	914400016	Switchcraft	L-12A	1
J6	BINDING POST, Red	915200008	Superior Elec.	DF-30RC	1
J7	BINDING POST, Black	915200009	Superior Elec.	DF-30BC	1
K1	RELAY, 1500Ω, 5.8 mA, P.C.Mtg.SPDT(1st L.O.)	912600026	Sigma	11FP1500G-SIL	1
M1	METER, Tautband, 200 μA Movement	911800060	API Weston	A01895700	1
P1	LINE CORD, 18/3, SV 8Ft. w/plug	916400017	Belden	17238	1
	For 230 volt operation insure tag is attached to plug which reads: WARNING 230 volt operation only.				
R1	RESISTOR, Factory Selected For Meter, Linearity				1
S1	SWITCH, Rotary, 3 Pole, 3 Pos.	911200134	Oak Type F	Sierra A2385500	1
TP3	INSULATOR, Feed Thru Teflon	915100029	Lerco	6090	1
XF1	FUSE HOLDER	913400014	Littelfuse	342004	2
XF2	Same as XF1				

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	POWER SUPPLY, B02051200				
C1	CAPACITOR, Type PFP W/Insul;. Cover 500 µF, 50V	902200507	Mallory	TS-19021	3
C2	CAPACITOR, Verti-Lytic 25 µF, 50V	902220256	Sprague	VL-1310 6234-J	1
C3	Same as C1				
C4	Same as C1				
C5	CAPACITOR, .05 µF, 100V	901100503	El Menco	1DP-2-503	1
C6	CAPACITOR, Disc Ceramic 2X.02	901410203	Sprague		1
C7	Part of C6 (2 Sec.)				
C8	CAPACITOR, Vert. Mtg. Plastic Encased 50 µF 25V NP	903300506	Nashville Elec.	16-437BP-50-25S85 NP	1
CR1	DIODE, Zener, 1N707A 7.1V	910500032	International Rect.	1N707A	1
CR2	RECTIFIER, Silison, 600 PIV, 750 mA, D1 56	910800008	Diode Inc.	DI 56	5
CR3	Same as CR2				
CR4	Same as CR2				
CR5	Same as CR2				
CR6	Same as CR2				
E1	HEAT SINK	921300001	Birtcher	3AL-672	1
Q1	TRANSISTOR, NPN, 2N706A	910300022	Motorola	2N706A	1
Q2	TRANSISTOR, PNP, 2N508	910300015	Motorola	2N508	2
Q3	Same as Q2				
Q4	TRANSISTOR, PNP, 2N375	910300021	Motorola	2N375	1
R1	RESISTOR, Fixed Composition, 3300 ±5%, 1/4W	906900332	Speer		2
R2	POTENTIOMETER, 25 Turn, Type R,500Ω, 1/4W	907900102	AB	Type R	1
R3	RESISTOR, Fixed Composition, 5600 ±5%, 1/4W	906900562	Speer		1
R4	RESISTOR, Fixed Composition, 56K ±5%, 1/4W	906900563	Speer		1
R5	RESISTOR, Fixed Composition, 220K ±5%, 1/4W	906900224	Speer		1
R6	RESISTOR, Fixed Composition, 4700 ±5%, 1/4W	906900472	Speer		1
R7	Same as R1				
R8	RESISTOR, Fixed Composition, 6800 ±5%, 1/4W	906900682	Speer		1
R9	RESISTOR, Fixed Composition, 10K ±5%, 1/4W	906900103	Speer		1
R10	Not Used				
R11	RESISTOR, Fixed Composition, 10 ±10%, 2W	906000100	AB	Type HB	1
R12	RESISTOR, Fixed Composition, 82Ω ±10%, 2W	906000820	AB		1
T1	TRANSFORMER, 115/230 VAC - 25VAC	910000090		A02300700	1
XQ1	SOCKET TRANSISTOR, 3 Pin	914200036	Grayhill	22-16-3	3

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	POWER SUPPLY, B02051200 (Continued)				
XQ2	Same as XQ1				
XQ3	Same as XQ1				
	AUDIO, C02051100				
C1	CAPACITOR, Disc Ceramic, 0.1 µF, 50V	901410104	Sprague	33C41	13
C2	CAPACITOR, Disc Ceramic, .01 µF, 150V	901440103	Centralab	DDM-103	3
C3	CAPACITOR, Vert. Mtg. Plastic Encased, 10 µF 25V, Normal Position	903300106	Nashville Elect.	12-375BP10-25S85NP	4
C4	Same as C1				
C5	CAPACITOR, Dura Mica, 47 pF ±5%, 500V	901900470	El Menco	DM15-470J	1
C6	CAPACITOR, Dura Mica, 3000 pF ±5%, 500V	901900302	El Menco	DM19-302J	1
C7	CAPACITOR, Vert. Mtg. Plastic Encased 50 µF, 25V, Normal Position	903300506	Nashville Elect.	16-437BP50-25S85NP	3
C8	Same as C1				
C9	Same as C1				
C10	Same as C7				
C11	Same as C3				
C12	Same as C7				
C13	Same as C3				
C14	Same as C3				
C15	CAPACITOR, Vert. Mtg. Plastic Encased 22 µF, 25V, Normal Position	903300226	Nashville Elect.	16-375BP22-25S85NP	1
C16	Same as C1				
C17	Same as C1				
C18	CAPACITOR, Dura Mica, 390 pF ±5%, 500V	901900391	El Menco	DM15-391J	2
C19	Same as C1				
C20	Same as C1				
C21	Same as C1				
C22	Same as C1				
C23	CAPACITOR, Dura Mica 68 pF ±5%, 500V	901910680	El Menco	DM15-680J	2
C24	Same as C18				
C25	Same as C1				
C26	Same as C1				
C27	Same as C23				
C28	Same as C2				
C29	Same as C2				
C30	Same as C1				
E1	HOLDING CLIP, Crystal, Steel	921100004	Augat	8000-HP3	2
E2	Same as E1				

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	AUDIO, C02051100 (Continued)				
L1	INDUCTOR, Variable	A01897400	Sierra	A01897400	3
L2	INDUCTOR, Fixed 3.3 mH	909000116	J.W. Miller	70F333A1	1
L3	Same as L1				
L4	Same as L1				
L5	INDUCTOR, Fixed 24 µH, Molded	909000121	Delevan	1537-46	2
L6	Same as L5				
R1	RESISTOR, Fixed Composition, 56K ±5%, 1/4W	906900563	Speer		1
R2	RESISTOR, Fixed Composition, 33K ±5%, 1/4W	906900333	Speer		1
R3	RESISTOR, Fixed Composition, 100K ±5%, 1/4W	906900104	Speer		1
R4	RESISTOR, Fixed Composition, 47Ω ±5%, 1/4W	906900470	Speer		1
R5	RESISTOR, Fixed Composition, 6800 ±5%, 1/4W	906900682	Speer		1
R6	RESISTOR, Fixed Composition, 1000 ±5%, 1/4W	906900102	Speer		2
R7	RESISTOR, Fixed Composition, 22K ±5%, 1/4W	906900223	Speer		2
R8	RESISTOR, Fixed Composition, 120K ±5%, 1/4W	906900124	Speer		1
R9	RESISTOR, Fixed Composition, 2200 ±5%, 1/4W	906900222	Speer		5
R10	RESISTOR, Fixed Composition, 4700 ±5%, 1/4W	906900472	Speer		3
R11	RESISTOR, Fixed Composition, 5600 ±5%, 1/4W	906900562	Speer		
R12	Same as R7				
R13	RESISTOR, Fixed Composition, 560 ±5%, 1/4W	906900561	Speer		2
R14	RESISTOR, Fixed Composition, 10K ±5%, 1/4W	906900103	Speer		4
R15	Same as R13				
R16	RESISTOR, Fixed Composition, 39K ±5%, 1/4W	906900393	Speer		1
R17	Same as R14				
R18	Same as R6				
R19	Same as R14				
R20	RESISTOR, Fixed Composition, 8200 ±5%, 1/4W	906900822	Speer		2
R21	Same as R10				
R22	RESISTOR, Fixed Composition, 2700 ±5%, 1/4W	906900272	Speer		2
R23	RESISTOR, Fixed Composition, 270 ±5%, 1/4W	906900271	Speer		2
R24	RESISTOR, Fixed Composition, 1500 ±5%, 1/4W	906900152	Speer		2
R25	RESISTOR, Fixed Composition, 12K ±5%, 1/4W	906900123	Speer		2
R26	RESISTOR, Fixed Composition, 100 ±5%, 1/4W	906900101	Speer		2
R27	Same as R9				
R28	Same as R9				
R29	Same as R14				
R30	Same as R20				
R31	Same as R10				
R32	Same as R22				
R33	Same as R23				
R34	Same as R24				
R35	Same as R25				
R36	Same as R26				
R37	Same as R9				
R38	Same as R9				
R39	POTENTIOMETER, 10K, 2W	907900037	AB	Per SS-393-3-37	1

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	AUDIO, C02051100 (Continued)				
S1-5	Not Used				
S6	SWITCH, Rotary, 2 Pole, 3 Pos.	911200058	Oak	SS-14206-1	1
Q1	TRANSISTOR, PNP, 2N2360	910300017	Philco	2N2360	1
Q2	TRANSISTOR, PNP, 2N1745	910300020	Philco	2N1745	3
Q3	TRANSISTOR, PNP, 2N1728	910300008	Philco	2N1728	4
Q4	Same as Q3				
Q5	TRANSISTOR, PNP, 2N414	910300004	Raytheon	2N414	1
Q6	Same as Q3				
Q7	Same as Q2				
Q8	Same as Q3				
Q9	Same as Q2				
Y1	CRYSTAL, 2213.500 kHz	912200028	Wright	A01896900	1
Y2	CRYSTAL, 2216.500 kHz	912200029	Wright	A01896800	1
	SELECTIVITY, A02384700				
C1	Not Used				
C2	CAPACITOR, Feed Thru, 1000 pF, 500V	902640102	Erie	1201-052	2
C3	Not Used				
C4	Not Used				
C5	Same as C2				
FL1	Not Used				
FL2	FILTER, Crystal, 3100 Hz	910100017	Blackhawk	A02088500	1
J1-24	Not Used				
J25	CONNECTOR, Screw Type, Bulkhead	914600099	Amp	329852	1
L1	INDUCTOR, Fixed, 3.3 mH	909000116	J.W. Miller	70F333A1	1
R1	RESISTOR, Fixed Composition, 560Ω ±5%, 1/4W	906900561	Speer		1

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	SELECTIVITY, A02384600				
C1	CAPACITOR, Feed Thru, 1000 pF, 500V	902640102	Erie	1201-052	4
C2	Not Used				
C3	Same as C1				
C4	Same as C1				
C5	Not Used				
C6	Same as C1				
FL1	FILTER, Crystal, 250 Hz	910100004	Blackhawk	SS-14486-1	1
J1-22	Not Used				
J23	CONNECTOR, Screw Type, Bulkhead	914600099	Amp	329852	2
J24	Same as J23				
	I.F. BUFFERS, B02384300				
C1	CAPACITOR, Dura Mica, 220 pF ±5%, 500V	901900221	El Menco	DM15-221 J	1
C2	CAPACITOR, .01 Disc Ceramic, 150V	901440103	Centralab	DDM-103	10
C3	Same as C2				
C4	Same as C2				
C5	Same as C2				
C6	Same as C2				
C7	Same as C2				
C8	Same as C2				
C9	Same as C2				
C10	Same as C2				
C11	Same as C2				
K1	RELAY, SPDT	912600030	Reed	A02400000	1
L1	INDUCTOR, 24 μH, Molded	909000121	Delevan	1537-46	1
Q1	TRANSISTOR, 2N3640, PNP	910300047	Fairchild	2N3640	1
Q2	Same as Q1				
R1	RESISTOR, Fixed Composition, 2.2K ±5%, 1/4W	906900222	Speer		2
R2	RESISTOR, Fixed Composition, 22K ±5%, 1/4W	906900223	Speer		2

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	I.F. BUFFERS, B02384300 (Continued)				
R3	RESISTOR, Fixed Composition, 180 ±5%, 1/4W	906900181	Speer		1
R4	RESISTOR, Fixed Composition, 100 ±5%, 1/4W	906900101	Speer		1
R5	RESISTOR, Fixed Composition, 1000 ±5%, 1/4W	906900102	Speer		3
R6	Same as R5				
R7	RESISTOR, Fixed Composition, 3000 ±5%, 1/4W	906900302	AB		2
R8	Same as R1				
R9	Same as R2				
R10	Not Used				
R11	RESISTOR, Variable, 25 Turn, 150Ω, Type RP	907900171	AB	RP 151M	1
R12	Same as R5				
R13	RESISTOR, Fixed Composition, 820 ±5%, 1/4W	906900821	Speer		1
R14	Same as R7				
R15	RESISTOR, Fixed Composition, 220 ±5%, 1/4W	906900221	Speer		1
R16	RESISTOR, Fixed Composition, 120Ω ±5%, 1/4W	906900121	Speer		1
	NARROW BAND EMITTER FOLLOWER, B02384400				
C1	CAPACITOR, .01 Disc Ceramic, 150V	901440103	Centralab	DDM-103	4
C2	Same as C1				
C3	Same as C1				
C4	Same as C1				
K1	RELAY	912600030	Reed	A02400000	1
Q1	TRANSISTOR, 2N3640	910300047	Fairchild	2N3640	1
R1	RESISTOR, Fixed Composition, 3900 ±5%, 1/4W	906900392	Speer		1
R2	RESISTOR, Fixed Composition, 100 ±5%, 1/4W	906900101	Speer		1
R3	RESISTOR, Fixed Composition, 8200 ±5%, 1/4W	906900822	Speer		1
R4	RESISTOR, Fixed Composition, 39K ±5%, 1/4W	906900393	Speer		1
R5	RESISTOR, Fixed Composition, 12K ±5%, 1/4W	906900123	Speer		1
R6	RESISTOR, Fixed Composition, 33K ±5%, 1/4W	906900333	Speer		1
	WIDEBAND EMITTER FOLLOWERS (2), B02384500				
C1	CAPACITOR, .01 Disc Ceramic, 150V	901440103	Centralab	DDM-103	5
C2	Same as C1				
C3	Same as C1				
C4	Same as C1				
C5	Same as C1				

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	WIDEBAND EMITTER FOLLOWERS (2), B02384500 (Continued)				
K1	RELAY	912600030	Reed	A02400000	1
Q1	TRANSISTOR, 2N3640	910300047	Fairchild	2N3640	2
Q2	Same as Q1				
R1	RESISTOR, Fixed Composition, 1800 ±5%, 1/4W	906900182	Speer		1
R2	RESISTOR, Fixed Composition, 2200 ±5%, 1/4W	906900222	Speer		1
R3	RESISTOR, Fixed Composition, 8200 ±5%, 1/4W	906900822	Speer		1
R4	RESISTOR, Fixed Composition, 33K ±5%, 1/4W	906900333	Speer		2
R5	RESISTOR, Fixed Composition, 39K ±5%, 1/4W	906900393	Speer		2
R6	RESISTOR, Fixed Composition, 12K ±5%, 1/4W	906900123	Speer		1
R7	Same as R4				
R8	Same as R5				
R9	RESISTOR, Fixed Composition, 33K ±5%, 1/4W	906900333	Speer		1
	MIXER MODULE, A02050100				
C1	CAPACITOR, Silver Mica, 5 pF ±20%, 500V	902040050	El Menco	CM15C050M	1
C2	CAPACITOR, Silver Mica, 50 pF ±2%, 500V	902070500	El Menco	CM15E500G	1
C3	CAPACITOR, Silver Mica, 82 pF ±2%, 500V	902050820	El Menco	CM15E820G	1
C4	CAPACITOR, Silver Mica, 12 pF ±5%, 500V	902010120	El Menco	CM15E120J	1
C5	CAPACITOR, Silver Mica, 33 pF ±2%, 500V	902070330	El Menco	CM15E330G	3
C6	Same as C5				
C7	CAPACITOR, Silver Mica, 100 pF ±5%, 500V	902010101	El Menco	CM15E101J	2
C8	Same as C7				
C9	CAPACITOR, Silver Mica, 10 pF ±5%, 500V	902010100	El Menco	CM15E100J	1
C10	CAPACITOR, Silver Mica, 39 pF ±5%, 500V	902010390	El Menco	CM15E390J	1
C11	Same as C5				
C12	CAPACITOR, Disc Ceramic, 0.1 µF, 50V	901410104	Sprague	33C41	1
C13	CAPACITOR, Tubular Ceramic, 27 pF, NPO	901400270	Centralab	TCZ27	3
C14	CAPACITOR, Ceramic, NPO-C1, 0.68 pF	901410068	Aero Vox	CC21CKR68C	1
C15	Same as C13				
C16	CAPACITOR, Ceramic, NPO-C1, 0.50 pF	901400005	Aero Vox	CC21CK0R5C	1
C17	Same as C13				
C18	CAPACITOR, Silver Mica, 220 pF ±2%, 500V	902070221	El Menco	CM15E221G	1
J1-16	Not Used				
J17	CONNECTOR, Solder Receptacle, Miniature	914600099	Amp	329852	2
J18-20	Not Used				
J21	Same as J17				
J22-29	Not Used				
J30	CONNECTOR, Coax Type BNC, Female	914600035	Gremar	UG 1094/U	2
J31	Same as J30				

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	MIXER MODULE, A02050100 (Continued)				
L1	INDUCTOR, Variable	909400050	Delevan	220-10/R	2
L2	INDUCTOR, Variable	909400048	Delevan	220-06/R	1
L3	Same as L1				
L4	INDUCTOR, Variable	909400049	Delevan	220-08/R	1
L5	INDUCTOR, Variable	A01985200	Sierra	A01985200	3
L6	Same as L5				
L7	Same as L5				
	FIRST MODULATOR, B02050300				
C1	CAPACITOR, Dura Mica, 5 pF, 500V	901900050	El Menco	DM15-050K	2
C2	CAPACITOR, Glass Piston, P.C. Mtg. .8-8.5 pF	903000885	Erie	563-013	2
C3	Same as C1				
C4	Same as C2				
CR1	DIODE, HD1871E	910500033	Hughes	HD1871E	2
CR2	Same as CR1				
R1	RESISTOR, Metal Film, 150Ω ±1%, 1/8W	907300002	Electra	MF 1/8	2
R2	Same as R1				
R3	RESISTOR, Variable, 25 Turn, Type R, 500Ω	907900102	AB		1
R4	RESISTOR, Metal Film, 274 ±1%, 1/8W	907300003	Electra	MF 1/8	2
R5	Same as R4				
R6	RESISTOR, Metal Film, 56.2K ±1%, 1/8W	907300001	Electra	MF 1/8	2
R7	Same as R6				
T1	TRANSFORMER, 1:1 Center Tapped Sec.	909900014	Pulse Eng.	PE 5864	1
	FIRST MIXER, B02050200				
C1	CAPACITOR, Vert. Mount., Plastic Encased, 1.0 µF, 25V, Normal Position	903300105	Nashville Elect.	8-250BP1-25S85NP	3
C2	CAPACITOR, Disc Ceramic, .01, 150V	901440103	Centralab	DDM-103	1
C3	Same as C1				
C4	Same as C1				
C5-18	Not Used				
C19	CAPACITOR, Feed Thru 1000 pF	902640102	Erie	1201-052	1

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	FIRST MIXER, B02050200 (Continued)				
Q1	TRANSISTOR, 2N2997, PNP	910300019	Texas Inst.	2N2997	1
R1	RESISTOR, Fixed Composition, 150 ±5%, 1/4W	906900151	Speer		1
R2	RESISTOR, Fixed Composition, 47K ±5%, 1/4W	906900473	Speer		1
R3	RESISTOR, Fixed Composition, 33K ±5%, 1/4W	906900333	Speer		1
R4	RESISTOR, Fixed Composition, 10Ω ±5%, 1/4W	906900100	Speer		1
R5	RESISTOR, Fixed Composition, 4700 ±5%, 1/4W	906900472	Speer		1
R6	RESISTOR, Fixed Composition, 1000 ±5%, 1/4W	906900102	Speer		1
R7	RESISTOR, Fixed Composition, 220 ±5%, 1/4W	906900221	Speer		1
	INCREMENTAL MIXER, B02327700				
C1	CAPACITOR, Vertical Mtg., Plastic Encased, 1 µF, 25 V, NP	903300105	Nashville Electronics	8-250BP1-25S85 NP	1
C2	CAPACITOR, Ceramic Disk, 0.01 µF, 150V	901440103	Centralab	DDM-103	1
C3	CAPACITOR, Dura Mica, 47 pF ±5%, 500V	901900470	El Menco	DM15-470J	1
C4	CAPACITOR, Dura Mica, 680 pF ±5%, 500V	901900681	El Menco	DM15-680J	1
L1	INDUCTOR, 68 µH, Nytronics, Inc.	909000131	Nytronics	WEF-68	1
L2	Inductor, Variable	A01897400	Sierra	A01897400	1
Q1	TRANSISTOR, 2N3563, NPN	910300042	Fairchild	2N3563	2
Q2	Same as Q1				
Q3	TRANSISTOR, 2N2997, PNP	910300019	Texas Inst.	2N2997	1
R1	RESISTOR, Fixed Composition, 270Ω ±5%, 1/4W	906900271	Speer		1
R2	RESISTOR, Fixed Composition, 15K ±5%, 1/4W	906900153	Speer		2
R3	RESISTOR, Fixed Composition, 6.8K ±5%, 1/4W	906900682	Speer		1
R4	RESISTOR, Fixed Composition, 33K ±5%, 1/4W	906900333	Speer		1
R5	Same as R2				
R6	RESISTOR, Fixed Composition, 2700Ω ±5%, 1/4W	906900272	Speer		1
	SECOND I.F., B02050500				
C1	CAPACITOR, Ceramic Disc .1, 50V	901410104	Sprague	33C41	1
C2	CAPACITOR, Vert. Mtg., Plastic Encased, 1.0 µF, 25V, Normal Position	903300105	Nashville	8-250BP1-25S85NP	1

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	SECOND I.F., B02050500 (Continued)				
C3	CAPACITOR, Ceramic Disc, .01, 150V	901440103	Centralab	DDM-103	1
C4	CAPACITOR, Dura Mica, 56 pF, 500V	901900560	El Menco	DM15-560J	1
C5-19	Not Used				
C20	CAPACITOR, Feed Thru 1000 pF	902640102	Erie	1201-052	1
L1	INDUCTOR, Variable	A01897400	Sierra	A01897400	1
Q1	TRANSISTOR, 2N2360, PNP	910300017	Philco	2N2360	1
R1	RESISTOR, Fixed Composition, 8.2K ±5%, 1/4W	906900822	Speer		1
R2	RESISTOR, Fixed Composition, 120K ±5%, 1/4W	906900124	Speer		1
R3	RESISTOR, Fixed Composition, 47Ω ±5%, 1/4W	906900470	Speer		1
R4	RESISTOR, Fixed Composition, 470 ±5%, 1/4W	906900471	Speer		2
R5	Same as R4				
R6	RESISTOR, Fixed Composition, 12K ±5%, 1/4W	906900123	Speer		1
R7	RESISTOR, Fixed Composition, 560Ω ±5%, 1/4W	906900561	Speer		1
RT1	THERMISTOR	913600002	Veco	38D2	1
	LUG, Solder #10	918400028	Birnbach	196	1
	ATTENUATOR, D01987000				
C1	CAPACITOR, Part of Attenuator Assembly				8
C2	CAPACITOR, Button Mica, 100 pF ±5%	901800101	Erie	2930-004	9
C3	Same as C1				
C4	Same as C2				
C5	Same as C1				
C6	Same as C2				
C7	Same as C1				
C8	Same as C2				
C9	Same as C1				
C10	Same as C2				
C11	Same as C1				
C12	Same as C2				
C13	Same as C1				
C14	Same as C2				
C15	CAPACITOR, Glass Piston, .7-14 pF	903000120	JFD	VC-11G	6
C16	Same as C2				
C17	Same as C15				
C18	Same as C2				

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	ATTENUATOR, D01987000 (Continued)				
C19	Same as C15				
C20	CAPACITOR, Button Mica, 68 pF ±5%	901800680	Erie	2930-004	2
C21	CAPACITOR, Glass Piston, 1-60 pF	903000600	JFD	B01985500	1
C22	Same as C20				
C23	CAPACITOR, Variable, .005-15 pF		Sierra	B01989000	1
C24	CAPACITOR, Silver Mica, 47 pF, 500V	902010470	El Menco	CM15E470J	1
C25	CAPACITOR, Silver Mica, 120 pF ±5%, 500V	902010121	El Menco	CM15E121J	1
C26	CAPACITOR, Silver Mica, 5 pF ±20%, 500V	902040050	El Menco	CM15C050M	1
C27	Same as C15				
C28	CAPACITOR, Silver Mica, 22 pF ±2%, 500V	902070220	El Menco	CM15C220G	1
C29	Same as C15				
C30	CAPACITOR, Silver Mica, 68 pF ±5%, 500V	902010680	El Menco	CM15E680J	1
C31	Same as C15				
C32	CAPACITOR, Feed Thru, 1000 pF 500V	902640102	Erie	1200-052	3
C33	Same as C32				
C34	Same as C32				
J1A	CONNECTOR, Type GR Panel Mounting	914600095	General Radio	874-PRLT	1
J1B	CONNECTOR, Adapter to BNC for 874-PRLT	914600089	General Radio	874-QBJL	1
L1	INDUCTOR, Fixed, 82 µH	909000124	Delevan	1537-72	1
R1	RESISTOR, Metal Film, 75Ω ±1%, 1W, 50 PPM	907600013	Electra	MF1	1
R2	RESISTOR, Metal Film, 135Ω ±1%, 1W, 50 PPM	907600012	Electra	MF1	1
R3	RESISTOR, Metal Film, 600Ω ±1%, 1W, 50 PPM	907600011	Electra	MF1	1
R4	RESISTOR, Fixed Composition, 22Ω ±5%, 1/4W	906900220	Speer		2
R5	Same as R4				
R6	RESISTOR, Fixed Composition, 82Ω ±5%, 1/4W	906900820	Speer		1
R7	RESISTOR, Fixed Composition, 33Ω ±5%, 1/4W	906900330	Speer		1
S1	Not Used				
S2	SWITCH	911200094	Oak	A01897100	1
	Detent for S2	911200103	Oak	A01896200	1
S3	SWITCH	911200088	Oak	A01896400	1
S4A	SWITCH	911200102	Oak	A01990400	1
S4BC	SWITCH	911200087	Oak	A01896300	1
	PREAMPLIFIER, B02163000				
C1	CAPACITOR, Disc Ceramic, 0.1 µF, 50V	901410104	Sprague	33C41	3
C2	Same as C1				
C3	Same as C1				

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	PREAMPLIFIER, B02163000 (Continued)				
C4	CAPACITOR, 22 µF, 25V, Non Polar, Vert. Mtg. Plastic Encased	903300226	Nashville Elect.	16-375BP22-25S85 NP	2
C5	CAPACITOR, 10 µF, 25V, Non Polar, Vert. Mtg. Plastic Encased	903300106	Nashville Elect.	12-375BP10-25S85 NP	1
C6	Same as C4				
C7	CAPACITOR, Dura Mica, 100 pF ±5%, 500V	901900101	El Menco	DM15-101	1
C8	CAPACITOR, Max-C, Trimmer Sealcap 1-60 pF	903010600	JFD	MC626Y	1
Q1	TRANSISTOR, NPN, 2N2483	910300038	Fairchild	2N2483	2
Q2	Same as Q1				
Q3	TRANSISTOR, NPN, 2N706B	910300024	Fairchild	2N706B	1
R1	RESISTOR, Fixed Composition, 22 Meg ±5%, 1/4W	906900226	Speer		1
R2	RESISTOR, Fixed Composition, 47K ±5%, 1/4W	906900473	Speer		1
R3	RESISTOR, Fixed Composition, 2.2 Meg ±5%, 1/4W	906900225	Speer		1
R4	RESISTOR, Fixed Composition, 1.5K ±5%, 1/4W	906900152	Speer		1
R5	RESISTOR, Fixed Composition, 150 ±5%, 1/4W	906900151	Speer		1
R6	RESISTOR, Fixed Composition, 47 ±5%, 1/4W	906900470	Speer		2
R7	Same as R6				
R8	RESISTOR, Fixed Composition, 680 ±5%, 1/4W	906900681	Speer		1
	GAIN REFERENCE, B01999500				
C1	CAPACITOR, .1 µF ±20%, Disc Ceramic, 50V	901410104	Sprague	33C41 A3	6
C2	Same as C1				
C3	Same as C1				
C4	Same as C1				
C5	CAPACITOR, Vertical Mounting, Plastic Encased, 10 µF, 25V Normal Position	903300106	Nashville Electronics	12-375BP10-25S85NP	1
C6	CAPACITOR, Dura Mica, 1500 pF ±5%, 500V	901900152	El Menco	DM19-152J	1
C7	CAPACITOR, Dura Mica, 330 pF ±5%, 500V	901900331	El Menco	DM19-331J	1
C8	Same as C1				
C9	Same as C1				
CR1	DIODE, Silicon, 1N815	910500010	Transistron	1N815	1
E1	HOLDING CLIP, Crystal, Steel	921100004	Augat	8000-HP3	1

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	GAIN REFERENCE, B01999500 (Continued)				
L1	INDUCTOR, 10 µH ±10%, Molded	909000125	Delevan	1537-36	1
L2	INDUCTOR, 24 µH, Molded	909000121	Delevan	1537-46	2
L3	Same as L2				
L4	INDUCTOR, Variable	A01897400	Sierra	A01897400	1
Q1	TRANSISTOR, 2N2368, NPN	910300026	Fairchild	2N2368	1
Q2	TRANSISTOR, 2N2360, PNP	210300017	Philco	2N2360	1
Q3	TRANSISTOR, 2N706A, NPN	910300022	Motorola	2N706A	1
R1	RESISTOR, Fixed Composition, 1000 ±5%, 1/4W	906900102	Speer		1
R2	RESISTOR, Fixed Composition, 1500 ±5%, 1/4W	906900152	Speer		1
R3	RESISTOR, Fixed Composition, 680 ±5%, 1/4W	906900681	Speer		1
R4	RESISTOR, Fixed Composition, 3300 ±5%, 1/4W	906900332	Speer		1
R5	RESISTOR, Fixed Composition, 2200 ±5%, 1/4W	906900222	Speer		1
R6	RESISTOR, Fixed Composition, 560 ±5%, 1/4W	906900561	Speer		1
R7	RESISTOR, Fixed Composition, 33000 ±5%, 1/4W	906900333	Speer		1
R8	RESISTOR, Fixed Composition, 3900 ±5%, 1/4W	906900392	Speer		1
R9	RESISTOR, Fixed Composition, 15000 ±5%, 1/4W	906900153	Speer		1
XY1	SOCKET, Crystal	914200007	Miller	33302	1
Y1	CRYSTAL, 1.000 MHz	912200026	Wright	A01896600	1
	OUTPUT AMPLIFIER, C02051000				
C1	CAPACITOR, Disc Ceramic, 0.1 µF, 50V	901410104	Sprague	33C41	10
C2	CAPACITOR, Disc Ceramic, .01 µF, 150V	901440103	Centralab	DDM-103	8
C3	Same as C1				
C4	Same as C2				
C5	CAPACITOR, Tubular Ceramic, 47 pF, N750	901420470	Centralab	TCN-47	1
C6	CAPACITOR, Dura Mica, 1200 pF ±5%, 500V	901900122	El Menco	DM19-122J	1
C7	Same as C2				
C8	Same as C1				
C9	CAPACITOR, Tubular Ceramic, 82 pF, N750	901400820	Centralab	TCN-82	1
C10	CAPACITOR, Dura Mica, 100 pF ±5%, 500V	901900101	El Menco	DM15-101J	1
C11	CAPACITOR, Feed Thru, 1000 pF, 500V	902640102	Erie	1200-052	1
C12	Same as C2				
C13	Not Used				
C14	CAPACITOR, Dura Mica, 220 pF ±5%, 500V	901900221	El Menco	DM15-221J	1
C15	Same as C2				
C16	Same as C1				

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	OUTPUT AMPLIFIER, C02051000 (Continued)				
C17	Same as C2				
C18	Same as C1				
C19	CAPACITOR, 0.1 µF	901420104			1
C20	Same as C2				
C21	Same as C1				
C22	Same as C1				
C23	Same as C1				
C24	Same as C1				
C25	Same as C1				
C26	Same as C2				
CR1	DIODE, Silicon, HD5000	910500041	Hughes	HD5000	2
CR2	Same as CR1				
K1	RELAY, Type 4	912600028	Sierra	A02772100	1
L1	INDUCTOR, Variable	A01897400	Sierra	A01897400	2
L2	Same as L1				
L3	INDUCTOR, Fixed, 24 µH, Molded	909000121	Delevan	1537-46	1
L4	INDUCTOR, Fixed, 3.3 mH	909000116	J. W. Miller	70F33A1	5
L5	Same as L4				
L6	Same as L4				
L7	Same as L4				
L8	Same as L4				
Q1	TRANSISTOR, PNP, 2N2360	910300017	Philco	2N2360	2
Q2	Same as Q1				
Q3	TRANSISTOR, PNP, 2N1745	910300020	Philco	2N1745	3
Q4	Same as Q3				
Q5	Same as Q3				
R1	RESISTOR, Fixed Composition, 470Ω ±5%, 1/4W	906900471	Speer		1
R2	RESISTOR, Fixed Composition, 4700 ±5%, 1/4W	906900472	Speer		1
R3	RESISTOR, Fixed Composition, 680 ±5%, 1/4W	906900681	Speer		1
R4	RESISTOR, Variable, 25 Turn, 500Ω	907900102	AB		1
R5	RESISTOR, Fixed Composition, 100Ω ±5%, 1/4W	906900101	Speer		1
R6	RESISTOR, Fixed Composition, 56K ±5%, 1/4W	906900563	Speer		3
R7	RESISTOR, Fixed Composition, 33K ±5%, 1/4W	906900333	Speer		1
R8	RESISTOR, Fixed Composition, 6800 ±5%, 1/4W	906900682	Speer		2
R9	RESISTOR, Fixed Composition, 47Ω ±5%, 1/4W	906900470	Speer		1
R10	RESISTOR, Fixed Composition, 27K ±5%, 1/4W	906900273	Speer		2
R11	Same as R6				

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	OUTPUT AMPLIFIER, C02051000 (Continued)				
R12	Same as R8				
R13	RESISTOR, Fixed Composition, 10Ω ±5%, 1/4W	906900100	AB	Type CB	1
R14	RESISTOR, Fixed Composition, 47K ±5%, 1/4W	906900473	Speer		2
R15	Same as R10				
R16	RESISTOR, Fixed Composition, 1000 ±5%, 1/4W	906900102	Speer		2
R17	RESISTOR, Fixed Composition, 18K ±5%, 1/4W	906900183	Speer		1
R18	Same as R6				
R19	RESISTOR, Variable, Type UPE-70, 2.5K ±20%	907900180	CTS		1
R20	RESISTOR, Fixed Composition, 560 ±5%, 1/4W	906900561	Speer		2
R21	Same as R16				
R22	Not Used				
R23	RESISTOR, Fixed Composition, 12K ±5%, 1/4W	906900123	Speer		2
R24	Same as R14				
R25	Same as R20				
R26	RESISTOR, Fixed Composition, 1800 ±5%, 1/4W	906900182	Speer		2
R27	RESISTOR, Fixed Composition, 5600 ±5%, 1/4W	906900562	Speer		3
R28	Same as R27				
R29	Same as R23				
R30	Same as R26				
R31	RESISTOR, Fixed Composition, 2200 ±5%, 1/4W	906900222	Speer		1
R32	RESISTOR, Fixed Composition, 180 ±5%, 1/4W	906900181	Speer		1
R33	Same as R27				
R34	POTENTIOMETER, 2W, 2500Ω, 10%, Linear Series HT321	907900152	CTS	35774	1
	SWITCH - MAIN TUNING, B02001500				
J1-13	Not Used				
J14	CONNECTOR, 90°, Screw Type P.C. Mounting	914600086	AMP	330732	3
J15	Same as J14				
J16	Same as J14				
R1	RESISTOR, Fixed Composition, 10K ±5%, 1/4W	906900103	Speer		1
R2	RESISTOR, Variable, 25 Turn, Type R, 10K	907900172	AB	RP-103U	1
S1	SWITCH, 2 Pole, 2 Pos., Type 22	911200099	Oak	B01893600	1

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	INCR. TUNING DIAL MECH. SUBASSEMBLY A02062300				
C1	CAPACITOR, Variable Air, 50-450 pF	902810451	Radio Condenser	A02008100	1
DS1	Not Used				
DS2	LAMP, Indicator, Green	913800023	Cal-Glo	75GB	1
	BULB, Replacement for Indicator DS2	913800028	Precision Lamp Engineers	No. 118	1
J1	Not Used				
J2	Not Used				
J3	CONNECTOR, BNC Panel, UG-1094/U	914600035	Amphenol	74868	1
R1	RESISTOR, Fixed Composition, 51Ω ±5%, 1/4W	906900510	AB	Type CB	1
	INCREMENTAL TUNING OSCILLATOR, B02001600				
C1	CAPACITOR, Tubular Ceramic, 10 pF, N330	901430100	Centralab	TCA10	1
C2	CAPACITOR, Tubular Ceramic, 39 pF, N150	901420390	Centralab	DA-320U	1
C3	CAPACITOR, Tubular Ceramic, 150 pF, NPO	901400151	Centralab	TCZ 150	1
C4	CAPACITOR, Dura Mica, 1500 pF ±5%, 500V	901900152	El Menco	DM19-152J	1
C5	CAPACITOR, Tubular Ceramic, 39 pF, NPO	901410390	Centralab	TCZ 39	1
C6	CAPACITOR, Glass Piston .7 - 14 pF	903000120	JFD	VC-11G	1
C7	CAPACITOR, Vertical Mounting, Plastic Encased, 10 µF, 25V, Normal Position	903300106	Nashville Elect.	12-375BP10-25S85NP	1
C8	CAPACITOR, Dura Mica, 4700 pF ±5%, 500V	901900472	El Menco	DM19-472J	1
C9	CAPACITOR, Disc Ceramic, .01 µF, 150V	901440103	Centralab	DDM-103	2
C10	CAPACITOR, Disc Ceramic, 0.1 µF, 50V	901410104	Sprague	33C41	1
C11	Same as C9				
L1	INDUCTOR, Variable	A01897300	Sierra	A01897300	1
Q1	TRANSISTOR, NPN, 2N706A	910300022	Motorola	2N706A	1
R1	RESISTOR, Fixed Composition, 8200 ±5%, 1/4W	906900822	Speer		1
R2	RESISTOR, Fixed Composition, 82K ±5%, 1/4W	906900823	Speer		1
R3	RESISTOR, Fixed Composition, 12K ±5%, 1/4W	906900123	Speer		1
R4	RESISTOR, Fixed Composition, 1000 ±5%, 1/4W	906900102	Speer		2
R5	RESISTOR, Fixed Composition, 390 ±5%, 1/4W	906900391	Speer		1

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	INCREMENTAL TUNING OSCILLATOR, B02001600 (Continued)				
R6	RESISTOR, Fixed Composition, 100K ±5%, 1/4W	906900104	Speer		1
R7	Same as R4				
R8	RESISTOR, Variable, 20K, Circuitrim	907900181	IRC	200-00	1
	OSCILLATOR KC SUBASSEMBLY, A02063500				
J1-17	Not Used				
J18	CONNECTOR, Screw Type, Bulkhead	914600099	Amp	329852	3
J19	Same as J18				
J20	Same as J18				
TP7	INSULATED TIP JACK, Yellow Nylon	914400007	Johnson	105-607	1
	FIRST L.F. AMPLIFIER, B02044400				
C1	CAPACITOR, Vertical Mounting, Plastic Encased, 22 µF, 25V	903300226	Nashville Elect.	16-375BP22-25S85NP	1
C2	CAPACITOR, Disc Ceramic, .1 µF, 50V	901410104	Sprague	33C41	2
C3	Same as C2				
C4	CAPACITOR, Disc Ceramic, .01 µF, 150V	901440103	Centralab	DDM-103	1
C5	CAPACITOR, Dura Mica, 220 pF ±5%	901900221	El Menco	DM15-221J	1
C6	Not Used				
K1	RELAY, 1500Ω, 5.8 mA dc, P.C. Mtg., SPDT, 1A Contacts	912600026	Sigma	11FP-1500G-PAL	1
L1	INDUCTOR, Fixed, 3.3 mH	909000116	J.W. Miller	70F333A1	1
L2	INDUCTOR, Fixed, 82 µH	909900124	Delevan	1537-72	1
Q1	TRANSISTOR, PNP, 2N1728	910300008	Philco	2N1728	2
Q2	Same as Q1				
Q3	TRANSISTOR, PNP, 2N414, Germanium Junction	910300004	Raytheon	2N414	1

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	FIRST L.F. AMPLIFIER, B02044400 (Continued)				
R1	RESISTOR, Variable, Type UPE-70, 100K	907900173	CTS	CTS 35442	1
R2	RESISTOR, Fixed Composition, 2.2K ±5%, 1/4W	906900222	Speer		1
R3	RESISTOR, Fixed Composition, 39K ±5%, 1/4W	906900393	Speer		1
R4	RESISTOR, Fixed Composition, 150 ±5%, 1/4W	906900151	Speer		1
R5	RESISTOR, Fixed Composition, 56 ±5%, 1/4W	906900560	Speer		1
R6	RESISTOR, Fixed Composition, 3.9K ±5%, 1/4W	906900392	Speer		2
R7	RESISTOR, Fixed Composition, 33K ±5%, 1/4W	906900333	Speer		1
R8	RESISTOR, Fixed Composition, 12K ±5%, 1/4W	906900123	Speer		1
R9	Same as R6				
R10	RESISTOR, Fixed Composition, 470 ±5%, 1/4W	906900471	Speer		1
R11	Not Used				
R12	Not Used				
R13	Not Used				
	SECOND OSCILLATOR, B02044600				
C1	CAPACITOR, .01 Disc Ceramic, 150V	901440103	Centralab	DDM-103	6
C2	CAPACITOR, Tubular Ceramic, 10 pF, NPO	901420100	Centralab	TCZ 10	1
C3	CAPACITOR, Tubular Ceramic, 30 pF, N750	901420300	Centralab	TCZ 33	1
C4	CAPACITOR, Tubular Ceramic, 150 pF, NPO	901400151	Centralab	TCZ 150	1
C5	CAPACITOR, Tubular Ceramic, 120 pF, NPO	901410121	Centralab	TCZ 120	1
C6	Same as C1				
C7	Same as C1				
C8	CAPACITOR, Dura Mica, 56 pF ±5%, 500V	901900560	El Menco	DM15-560J	1
C9	Same as C1				
C10	CAPACITOR, Dura Mica, 10 pF ±5%, 500V	901900100	El Menco	DM15-100J	1
C11	Same as C1				
C12	Same as C1				
CR1	VARICAP, V10	913600010	PSI	V10	1
L1	INDUCTOR, Variable, 1.3 - 3.7 µH	909400055	Delevan	220-12R	1
Q1	TRANSISTOR, 2N706B, NPN	910300024	Fairchild	2N706B	1
Q2	TRANSISTOR, 2N1745, PNP	910300020	Philco	2N1745	1
Q3	TRANSISTOR, 2N3640	910300047	Fairchild	2N3640	1
R1	RESISTOR, Fixed Composition, 39K ±5%, 1/4W	906900393	Speer		1
R2	RESISTOR, Fixed Composition, 5.6K ±5%, 1/4W	906900562	Speer		1
R3	RESISTOR, Fixed Composition, 120K ±5%, 1/4W	906900124	Speer		2
R4	Same as R3				

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	SECOND OSCILLATOR, B02044600 (Continued)				
R5	RESISTOR, Fixed Composition, 680 ±5%, 1/4W	906900681	Speer		1
R6	RESISTOR, Fixed Composition, 390 ±5%, 1/4W	906900391	Speer		1
R7	RESISTOR, Fixed Composition, 12K ±5%, 1/4W	906900123	Speer		1
R8	RESISTOR, Fixed Composition, 10K ±5%, 1/4W	906900103	Speer		1
R9	RESISTOR, Fixed Composition, 1000 ±5%, 1/4W	906900102	Speer		1
R10	RESISTOR, Fixed Composition, 180Ω ±5%, 1/4W	906900181	Speer		1
R11	RESISTOR, Fixed Composition, 27K ±5%, 1/4W	906900273	Speer		2
R12	Same as R11				
R13	RESISTOR, Fixed Composition, 3300 ±5%, 1/4W	906900332	Speer		1
	INCREMENTAL REFERENCE & MIXER, B02045000				
C1	CAPACITOR, .01 Disc Ceramic, 150V	901440103	Centralab	DOM-103	3
C2	Same as C1				
C3	CAPACITOR, Variable Ceramic, 2-8 pF, PC Mtg.	903200080	Erie	538-011-89R	1
C4	CAPACITOR, Tubular Ceramic, 100 pF, NPO	901420101	Centralab	TCZ 100	1
C5	Same as C1				
C6	CAPACITOR, Tubular Ceramic, 22 pF, NPO	901420220	Centralab	TCZ 22	1
C7	CAPACITOR, Tubular Ceramic, 47 pF, NPO	901410470	Centralab	TCZ 47	1
C8	CAPACITOR, 0.1 Disc Ceramic, 50V	901410104	Sprague	33C41	1
C9	CAPACITOR, Dura Mica, 5 pF, 500V	901900050	El Menco	DM15-050K	1
C10	CAPACITOR, Variable, Glass, .8-8.5 pF	903000885	Erie	563-013	2
C11	CAPACITOR, Dura Mica, 330 pF, 500V	901900331	El Menco	DM15-331J	5
C12	Same as C11				
C13	Same as C11				
C14	Same as C10				
C15	Same as C11				
C16	Same as C11				
CR1	DIODE, Matched Pair, MP3507	910500009	Kheem	AH1043	1 Pr.
CR2	Part of CR1				
L1	INDUCTOR, Fixed, 24 µH, Molded	909000121	Delevan	1537-46	1
L2	INDUCTOR, Variable, Glass, 1.05 µH, Nominal	909400053	JFD	LV5P102	1
Q1	TRANSISTOR, 2N706A, NPN	910300022	Motorola	2N706A	1
Q2	TRANSISTOR, 2N1745, PNP	910300020	Philco	2N1745	1

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	INCREMENTAL REFERENCE & MIXER, B02045000 (Continued)				
R1	RESISTOR, Fixed Composition, 680 ±5%, 1/4W	906900681	Speer		1
R2	RESISTOR, Fixed Composition, 15K ±5%, 1/4W	906900153	Speer		2
R3	RESISTOR, Fixed Composition, 22K ±5%, 1/4W	906900223	Speer		1
R4	RESISTOR, Fixed Composition, 2700 ±5%, 1/4W	906900272	Speer		1
R5	RESISTOR, Fixed Composition, 10K ±5%, 1/4W	906900103	Speer		2
R6	RESISTOR, Fixed Composition, 220 ±5%, 1/4W	906900221	Speer		2
R7	RESISTOR, Variable, 25 Turn, Type R, 500Ω	907900102	AB		1
R8	Same as R5				
R9	Same as R6				
R10	RESISTOR, Fixed Composition, 1.8K ±5%, 1/4W	906900182	Speer		1
R11	Same as R2				
R12	RESISTOR, Fixed Composition, 18K ±5%, 1/4W	906900183	Speer		1
R13	RESISTOR, Fixed Composition, 470 ±5%, 1/4W	906900471	Speer		1
T1	TRANSFORMER, 1:1 Ct. Sec.	909900014	Pulse Eng.	PE 5864	1
XQ1	SOCKET, Transistor, 3 Pin	914200036	Grayhill	22-16-3	2
XQ2	Same as XQ1				
XY1	SOCKET, Crystal	914200007	James Millen Mfg. Co.	33302	1
Y1	CRYSTAL, 18.585 MHz	912200027	Bliley	A01896100	1
	SECOND L.F. AMPLIFIER, B02002000				
C1	CAPACITOR, .01 Disc Ceramic, 150V	901440103	Centralab	DDM-103	2
C2	CAPACITOR, Dura Mica, 150 pF ±5%, 500V	901900151	El Menco	DM15-151J	1
C3	Same as C1				
C4	CAPACITOR, 0.1 µF, Disc Ceramic, 50V	901410104	Sprague	33C41	2
C5	CAPACITOR, Dura Mica, 120 pF ±5%, 500V	901900121	El Menco	DM15-121J	1
C6	Same as C4				
C7	CAPACITOR, 10 µF, 25V, Normal Position, Vertical Mounting, Plastic Encased	903300106	Nashville Electronics	12-375BP10-25S85NP	1
L1	INDUCTOR, 82 µH, Molded	909000124	Delevan	1537-72	1

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	LOW-PASS FILTER 125 KC, B02002200				
C1	CAPACITOR, Dura Mica, 56 pF ±5%	901900560	El Menco	DM15-560J	2
C2	CAPACITOR, Dura Mica, 180 pF ±5%	901900181	El Menco	DM15-181J	2
C3	CAPACITOR, 1 .0 µF, 25V dc, Vertical Mounting Plastic Encased, Non Polarized	903300105	Nashville Electronics	8-250BP1-25S85NP	1
C4	CAPACITOR, Dura Mica, 390 pF ±5%	901900391	El Menco	DM15-391J	2
C5	CAPACITOR, Dura Mica, 22 pF ±5%	901900220	El Menco	DM15-220J	2
C6	Same as C4				
C7	Same as C5				
C8	Same as C1				
C9	Same as C2				
L1	INDUCTOR, Fixed, 10.5 mH	A02001200	Sierra	A02001200	2
L2	INDUCTOR, Fixed, 13.5 mH	A02001300	Sierra	A02001300	1
L3	Same as L1				
R1	RESISTOR, Fixed Composition, 5600 ±5%, 1/4W	906900562	Speer		1
	INCREMENTAL LOCK INDICATOR, B02002300				
C1	CAPACITOR, 22 µF, 25V, Normal Position, Vertical Mounting, Plastic Encased	903300226	Nashville Electronics	16-375BP22-25S85NP	2
C2	CAPACITOR, 0.1, Disc Ceramic, 50V	901410104	Sprague	33C41	2
C3	Same as C1				
C4	Same as C2				
C5	CAPACITOR, 1.0 µF, 25V, Normal Position, Vertical Mounting, Plastic Encased	903300105	Nashville Electronics	8-250BP1-25S85NP	1
CR1	DIODE, Silicon, 1N815	910500010	Transitron	1N815	1
K1	RELAY, 1500Ω, 5.8 mA dc, P.C. Mounting, SPDT 1a Contacts	912600026	Sigma	11FP-1500G-PAL	1
Q1	TRANSISTOR, 2N706A, NPN	910300022	Motorola	2N706A	3
Q2	Same as Q1				
Q3	Same as Q1				

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	INCREMENTAL LOCK INDICATOR, B02002300 (Continued)				
R1	RESISTOR, Fixed Composition, 220K ±5%, 1/4W	906900224	Speer		1
R2	RESISTOR, Fixed Composition, 3300 ±5%, 1/4W	906900332	Speer		1
R3	RESISTOR, Fixed Composition, 6800 ±5%, 1/4W	906900682	Speer		1
R4	RESISTOR, Fixed Composition, 1200 ±5%, 1/4W	906900122	Speer		1
R5	RESISTOR, Fixed Composition, 1500 ±5%, 1/4W	906900152	Speer		1
R6	RESISTOR, Fixed Composition, 150Ω ±5%, 1/4W	906900151	Speer		1
R7	RESISTOR, Fixed Composition, 18K ±5%, 1/4W	906900183	Speer		1
R8	RESISTOR, Fixed Composition, 8200 ±5%, 1/4W	906900822	Speer		1
	MAIN TUNING DIAL MECH. SUBASSEMBLY, A02062200				
C1	CAPACITOR, Variable Air, 7-75 pF	902810750	Hammarlund	9420-17-1003	1
DS1	LAMP, Indicator Green	913800023	Cal-Glo	75GB	1
	BULB, Replacement for Indicator DS1	913800028	Precision Lamp Engineers	No. 118	1
J1	Not Used				
J2	CONNECTOR, BNC Panel, UG-1094/U	914600035	Amphenol	74868	1
	MAIN TUNING OSCILLATOR, B01999600				
C1	CAPACITOR, Vertical Mounting, Plastic Encased, 1.0 µF, 25V, Normal Position	903300105	Nashville Elect.	8-250BP1-25S85NP	1
C2	CAPACITOR, Disc Ceramic, .01 µF, 150V	901440103	Centralab	DDM-103	6
C3	Same as C2				
C4	Same as C2				
C5	Same as C2				
C6	CAPACITOR, Tubular Ceramic, 12 pF, N750	901420120	Centralab	TCN 12	1
C7	CAPACITOR, Tubular Ceramic, 30 pF , NPO	901900300	Centralab		1
C8	CAPACITOR, Variable Glass, .7-14 pF	903000120	JFD	VC-11G	1
C9	CAPACITOR, Tubular Ceramic, 68pF , NPO	901420680	Centralab		1
C10	CAPACITOR, Dura Mica, 100 pF ±5%, 500V	901900101	El Menco		1
C11	CAPACITOR, Dura Mica, 3 pF, 500V	901900030	El Menco	DM15-030K	2
C12	Same as C11				
C13	Same as C2				
C14	Same as C2				
CR1	VARICAP V10	913600010	PSI	V10	1

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	MAIN TUNING OSCILLATOR, B01999600 (Continued)				
L1	INDUCTOR, Variable Glass, .56 Nom. µH	909400052	JFD	LV5P056	1
L2	INDUCTOR, Fixed Molded, 24 µH	909000121	Delevan	1537-46	1
Q1	TRANSISTOR, 2N706B, NPN	910300024	Fairchild	2N706B	1
Q2	TRANSISTOR, 2N2360, PNP	910300017	Philco	2N2360	1
R1	RESISTOR, Fixed Composition, 100Ω ±5%, 1/4W	906900101	Speer		3
R2	RESISTOR, Fixed Composition, 39K ±5%, 1/4W	906900393	Speer		1
R3	RESISTOR, Fixed Composition, 5600 ±5%, 1/4W	906900562	Speer		1
R4	RESISTOR, Fixed Composition, 680 ±5%, 1/4W	906900681	Speer		1
R5	RESISTOR, Fixed Composition, 4700 ±5%, 1/4W	906900472	Speer		1
R6	RESISTOR, Fixed Composition, 3300 ±5%, 1/4W	906900332	Speer		1
R7	RESISTOR, Fixed Composition, 22K ±5%, 1/4W	906900223	Speer		1
R8	RESISTOR, Fixed Composition, 330 ±5%, 1/4W	906900331	Speer		2
R9	RESISTOR, Fixed Composition, 2200 ±5%, 1/4W	906900222	Speer		1
R10	Same as R8				
R11	Same as R1				
R12	Same as R1				
	MAIN TUNING OSC. MC SUBASSEMBLY A02063600				
J1-7	Not Used				
J8	CONNECTOR, Screw Type, Bulkhead	914600099	Amp	329852	6
J9	Same as J8				
J10	Same as J8				
J11	Same as J8				
J12	Same as J8				
J13	Same as J8				
	MAIN TUNING FOLLOWER, B02044800				
C1	CAPACITOR, Dura Mica, 750 pF ±5%, 300V	901900751	El Menco	DM15-751J	1
C2	CAPACITOR, Disc Ceramic, 0.1 µF, 50V	901410104	Sprague	33C41	1
C3	CAPACITOR, Vert. Mtg. Plastic Encased, 1.0 µF, 25V, Normal Position	903300105 903300105	Nashville Elect.	8-250BP1-25S85NP	1
C4	CAPACITOR, Dura Mica, 5 pF, 500V	901900050	El Menco	DM15-050K	1
C5	CAPACITOR, Disc Ceramic, .01 µF, 150V	901440103	Centralab	DDM-103	1
K1	RELAY, Reed 18 VDC 2000Ω ±10%, PCB Mtg.	912600051	Phipps	PS-646	1

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	MAIN TUNING FOLLOWER, B02044800 (Continued)				
L1	INDUCTOR, Fixed, 680 µH Molded	909000122	Delevan	4500-68	1
L2	INDUCTOR, Fixed, 3.3 µH	909000116	J. W. Miller	70F333A1	1
R1	RESISTOR, Fixed Composition, 12K ±5%, 1/4W	906900123	Speer		1
R2	RESISTOR, Fixed Composition, 33K ±5%, 1/4W	906900333	Speer		1
R3	RESISTOR, Fixed Composition, 1000 ±5%, 1/4W	906900102	Speer		1
R4	RESISTOR, Fixed Composition, 68 ±5%, 1/4W	906900680	AB	Type CB	1
R5	RESISTOR, Fixed Composition, 100Ω, ±5%, 1/4W	906900101			1
Q1	TRANSISTOR, NPN, 2N3641	910300044	Fairchild	2N3641	1
	100 KC OSCILLATOR & HARMONIC GENERATOR B02002600				
C1	CAPACITOR, Vertical Mounting, Plastic Encased, 10 µF, 25V, Normal Position	903300106	Nashville Elect.	16-375BP10-25S85NP	2
C2	CAPACITOR, Disc Ceramic, 0.1 µF, 50V	901410104	Sprague	33C41	1
C3	CAPACITOR, Variable Glass, .8-8.5 pF	903000885	Erie	563-013	1
C4	CAPACITOR, Dura Mica, 27 pF ±5%, 500V	901900270	El Menco	DM15-270J	1
C5	CAPACITOR, Dura Mica, 1500 pF ±5%, 500V	901910152	El Menco	DM19-152J	1
C6	CAPACITOR, Dura Mica, 560 pF ±5%, 500V	901900561	El Menco	DM15-561J	1
C7	CAPACITOR, Dura Mica, 5600 pF ±5%, 500V	901900562	El Menco	DM19-562J	1
C8	CAPACITOR, Dura Mica, 330 pF ±5%, 500V	901900331	El Menco	DM15-331J	1
C9	CAPACITOR, Dura Mica, 18 pF ±5%, 500V	901900180	El Menco	DM15-180J	1
C10	Same as C1				
C11	CAPACITOR, Dura Mica, 10 pF ±5%, 500V	901900100	El Menco	DM15-100J	1
L1	INDUCTOR, Variable	A01897200	Sierra	A01897200	1
L2	INDUCTOR, Fixed, 82 µH, Molded	909000124	Delevan	1537-72	1
Q1	TRANSISTOR, NPN, 2N706A	910300022	Motorola	2N706A	4
Q2	Same as Q1				
Q3	Same as Q1				
Q4	Same as Q1				
R1	RESISTOR, Fixed Composition, 10K ±5%, 1/4W	906900103	Speer		2
R2	Same as R1				
R3	RESISTOR, Fixed Composition, 4700 ±5%, 1/4W	906900472	Speer		1
R4	RESISTOR, Fixed Composition, 82 ±5%, 1/4W	906900820	Speer		1
R5	RESISTOR, Fixed Composition, 6800 ±5%, 1/4W	906900682	Speer		1

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	100 KC OSCILLATOR & HARMONIC GENERATOR B02002600 (Continued)				
R6	RESISTOR, Fixed Composition, 1000 ±5%, 1/4W	906900102	Speer		1
R7	RESISTOR, Fixed Composition, 1000 ±5%, 1/2W	905000102	AB	Type EB	2
R8	RESISTOR, Fixed Composition, 12K ±5%, 1/4W	906900123	Speer		1
R9	RESISTOR, Fixed Composition, 5600 ±5%, 1/4W	906900562	Speer		1
R10	Same as R7				
R11	RESISTOR, Fixed Composition, 68 ±5%, 1/4W	906900680	AB	Type CB	1
R12	RESISTOR, Fixed Composition, 47K ±5%, 1/4W	906900473	Speer		1
R13	RESISTOR, Fixed Composition, 33K ±5%, 1/4W	906900333	Speer		1
R14	RESISTOR, Fixed Composition, 3300 ±5%, 1/4W	906900332	Speer		1
Y1	CRYSTAL, 100.000 KC W/Wire Leads	912200030	Bliley	A01896000	1
	MAIN TUNING MIXER, B02002700				
C1	CAPACITOR, .01 Disc Ceramic, 150V	901440103	Centralab	DDM-103	1
C2	CAPACITOR, Dura Mica, 100 pF ±5%, 500V	901900101	El Menco	DM15-101J	1
C3	CAPACITOR, Variable, Ceramic, 2-8 pF, P.C. Mtg.	903200080	Erie	538-011-89R	2
C4	CAPACITOR, Dura Mica, 220 pF ±5%, 500V	901900221	El Menco	DM15 221J	1
C5	CAPACITOR, Dura Mica, 330 pF ±5%, 500V	901900331	El Menco	DM15-331J	2
C6	Same as C5				
C7	CAPACITOR, Dura Mica, 5 pF, 500V	901900050	El Menco	DM15-050K	1
C8	Same as C3				
C9	CAPACITOR, .1 Disc Ceramic, 50V	901410104	Sprague	33C41	1
CR1	DIODE, 1N995	910500003	Transitron	1N995	1
CR2	DIODE, Hot Carrier		HPA	5082-2900	2
CR3	Same as CR2	910500069			
Q1	TRANSISTOR, 2N2360, PNP	910300017	Philco	2N2360	1
R1	RESISTOR, Fixed Composition, 4700 ±5%, 1/4W	906900472	Speer		1
R2	RESISTOR, Fixed Composition, 15K ±5%, 1/4W	906900153	Speer		1
R3	RESISTOR, Fixed Composition, 560 ±5%, 1/4W	906900561	Speer		1
R4	RESISTOR, Fixed Composition, 1000 ±5%, 1/4W	906900102	Speer		1
R5	RESISTOR, Fixed Composition, 220Ω ±5%, 1/4W	906900221	Speer		3
R6	RESISTOR, Fixed Composition, 10K ±5%, 1/4W	906900103	Speer		2
R7	Same as R6				
R8	Same as R5				
R9	Same as R5				
R10	POTENTIOMETER, 500Ω ±20%, 3/10W, Type UPM-70	907900174	CTS	35370	1

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	MAIN TUNING MIXER, B02002700 (Continued)				
R11	RESISTOR, Fixed Composition, 12Ω ±5%, 1/4W	906900120	Speer		1
R12	RESISTOR, Fixed Composition, 100Ω, ±5%, 1/4W	906900101			1
T1	TRANSFORMER, 1:1, Center Tapper Sec.	909900014	Pulse Eng.	PE5864	1
	LOW-PASS FILTER IN 50 KC, B02002900				
C1	CAPACITOR, Dura Mica, 560 pF ±5%, 500V	901900561	El Menco	DM15-561J	1
C2	CAPACITOR, Dura Mica, 150 pF ±5%, 500V	901900151	El Menco	DM15-151J	1
C3	CAPACITOR, Dura Mica, 1200 pF ±5%, 500V	901900122	El Menco	DM19-122J	1
L1	INDUCTOR, Fixed, 16.9 µH	A01921300	Sierra	A01921300	1
	LOW-PASS FILTER OUT, 50 KC, B02003000				
C1	CAPACITOR, Dura Mica, 680 pF ±5%, 500V	901900681	El Menco	DM15-681J	1
C2	CAPACITOR, Disc Ceramic, 0.1 µF, 50V	901410104	Sprague	33C41	1
L1	INDUCTOR, Fixed, 23mH	A01897600	Sierra	A01897600	1
L2	INDUCTOR, Fixed, 24 µH, Molded	909000121	Delevan	1537-46	1
R1	RESISTOR, Fixed Composition, 3900 ±5%, 1/4W	906900392	Speer		1
R2	RESISTOR, Fixed Composition, 33K ±5%, 1/4W	906900333	Speer		1
	AMPLIFIER-DETECTOR, B02002800				
C1	CAPACITOR, 22 µF, 25V, Normal Position, Vert. Mounting, Plastic Encased	903300226	Nashville Elect.	16-375BP22-25S85NP	3
C2	CAPACITOR, Vert. Mounting, Plastic Encased, 10 µF, 25V, Normal Position	903300106	Nashville Elect.	12-375BP10-25S85NP	1
C3	Same as C1				
C4	CAPACITOR, Dura Mica, 1200 pF ±5%, 500V	901900122	El Menco	DM19-122J	1
C5	Same as C1				

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	AMPLIFIER-DETECTOR, B02002800 (Continued)				
C6	CAPACITOR, Disc Ceramic, 0.1, 50V	901410104	Sprague	33C41	1
L1	INDUCTOR, Fixed, 8.1 mH	A01897500	Sierra	A01897500	1
L2	INDUCTOR, Fixed, 3.3 mH	909000116	J.W. Miller	70F333A1	1
Q1	TRANSISTOR, 2N3638, PNP	910300077			2
Q2	Same as Q1				
Q3	TRANSISTOR, 2N414, PNP	910300004	Raytheon	2N414	1
R1	RESISTOR, Fixed Composition, 33K ±5%, 1/4W	906900333	Speer		1
R2	RESISTOR, Fixed Composition, 39K ±5%, 1/4W	906900393	Speer		2
R3	RESISTOR, Fixed Composition, 3300Ω ±5%, 1/4W	906900332	Speer		1
R4	RESISTOR, Fixed Composition, 22K ±5%, 1/4W	906900223	Speer		1
R5	Same as R2				
R6	RESISTOR, Fixed Composition, 2700 ±5%, 1/4W	906900272	Speer		1
R7	RESISTOR, Fixed Composition, 1000 ±5%, 1/4W	906900102	Speer		2
R8	Same as R7				
R9	RESISTOR, Fixed Composition, 3900 ±5%, 1/4W	906900392	Speer		1
R10	RESISTOR, Fixed Composition, 100 ±5%, 1/4W	906900101	Speer		1
R11	RESISTOR, Fixed Composition, 47 ±5%, 1/4W	906900470	Speer		2
R12	Same as R11				
	MAIN LOCK INDICATOR, B02003100				
C1	CAPACITOR, Disc Ceramic, 0.1 µF, 50V	901410104	Sprague	33C41	2
C2	CAPACITOR, Vert. Mounting, Plastic Encased, 22 µF, 25V, Normal Position	903300226	Nashville Elect.	16-375BP22-25S85NP	2
C3	Same as C2				
C4	Same as C1				
C5	CAPACITOR, Fixed, 1.0µF	902700105			1
CR1	DIODE, 1N815, Silicon	910500010	Transitron	1N815	1
R1	RESISTOR, Fixed Composition, 220K ±5%, 1/4W	906900224	Speer		1
R2	RESISTOR, Fixed Composition, 3300 ±5%, 1/4W	906900332	Speer		1
R3	RESISTOR, Fixed Composition, 6800 ±5%, 1/4W	906900682	Speer		1
R4	RESISTOR, Fixed Composition, 1200 ±5%, 1/4W	906900122	Speer		1
R5	RESISTOR, Fixed Composition, 1500 ±5%, 1/4W	906900152	Speer		1
R6	RESISTOR, Fixed Composition, 150 ±5%, 1/4W	906900151	Speer		1
R7	RESISTOR, Fixed Composition, 18K ±5%, 1/4W	906900183	Speer		1

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	MAIN LOCK INDICATOR, B02003100 (Continued)				
R8	RESISTOR, Fixed Composition, 8200 ±5%, 1/4W	906900822	Speer		1
Q1	TRANSISTOR, NPN, 2N706B	910300024	Fairchild	2N706B	1
Q2	TRANSISTOR, NPN, 2N706A	910300022	Motorola	2N706A	2
Q3	Same as Q2				
	B-FILTER, B02003200				
C1	CAPACITOR, Disc Ceramic, .01 µF, 150V	901440103	Centralab	DDM-103	3
C2	Same as C1				
C3	CAPACITOR, Vert. Mtg. Plastic Encased, 22 µF, 25V Normal Position	903300226	Nashville Elect.	16-375BP22-25S85NP	1
C4	CAPACITOR, Disc Ceramic, 0.1 µF, 50V	901410104	Sprague	33C41	1
C5	Same as C1				
L1	INDUCTOR, Fixed, 3.30 mH	909000116	J.W. Miller	70F333A1	4
L2	Same as L1				
L3	Same as L1				
L4	Same as L1				
	IF OUTPUT AMPLIFIER, B02327900				
C1	CAPACITOR, Ceramic Disc, 0.001 µF, 500V	901400102	Erie	831-000-Z5UO-102P	5
C2	Same as C1				
C3	Same as C1				
C4	Same as C1				
C5	Same as C1				
CR1	DIODE, Silicon, 1N456	910500031	RCA	1N456	1
Q1	TRANSISTOR, 2N3563, NPN	910300042	Fairchild	2N3563	3
Q2	Same as Q1				
Q3	Same as Q1				

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	IF OUTPUT AMPLIFIER, B02327900 (Continued)				
R1	RESISTOR, Fixed Composition, 22K ±5%, 1/4W	906900223	Speer		2
R2	Same as R1				
R3	RESISTOR, Fixed Composition, 15K ±5%, 1/4W	906900153	Speer		1
R4	RESISTOR, Fixed Composition, 5600Ω ±5%, 1/4W	906900562	Speer		1
R5	POTENTIOMETER, Cermet, 500Ω, 1W/50°C, 42 Turn	907900223	CTS	171PCT501A	1
R6	RESISTOR, Fixed Composition, 10Ω ±5%, 1/4W	906900100	Speer		1
R7	RESISTOR, Fixed Composition, 1200Ω ±5%, 1/4W	906900122	Speer		1
R8	RESISTOR, Fixed Composition, 4700Ω ±5%, 1/4W	906900472	Speer		1
R9	RESISTOR, Fixed Composition, 1500Ω ±5%, 1/4W	906900152	Speer		1
R10	RESISTOR, Fixed Composition, 100Ω ±5%, 1/4W	906900101	Speer		1
	SECOND MODULATOR, B02327100				
C1	CAPACITOR, Dura Mica, 5 pF, 500V	901900050	El Menco	DM15-050K	2
C2	CAPACITOR, Glass Piston, P.C. Mtg. .8-8.5 pF	903000885	Erie	563-013	2
C3	Same as C1				
C4	Same as C2				
CR1	DIODE, 1N995	910500003			2
CR2	Same as CR1				
R1	RESISTOR, Metal Film, 150Ω ±1%, 1/8W	907300002	Electra	MF 1/8	2
R2	Same as R1				
R3	POTENTIOMETER, 25 Turn, Type R, 500Ω, 1/4W	907900102	AB	Type R	1
R4	RESISTOR, Metal Film, 274Ω ±1%, 1/8W	907300003	Electra	MF 1/8	2
R5	Same as R4				
R6	RESISTOR, Metal Film, 56.2K ±1%, 1/8W	907300001	Electra	MF 1/8	2
R7	Same as R6				
R8	RESISTOR, Fixed Composition, 56Ω ±5%, 1/4W	906900560	Speer		1
R9	RESISTOR, Fixed Composition, 220Ω ±5%, 1/4W	906900221	Speer		1
T1	TRANSFORMER, 1:1 Center Tapped Sec.	909900014	Pulse Eng.	PE5864	1

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	CABLE ASSEMBLIES FOR FREQUENCY SELECTIVE VOLTMETER - MODEL 128A				
	CABLE ASSEMBLY, Main Tuning Follower (J8) to First Modulator (J17)		Sierra	B02084501	1
	CABLE ASSEMBLY, Main Tuning Followers (J10) to Feedthru C5 (J30)		Sierra	B02052003	1
	CABLE ASSEMBLY, Low-Pass Filter Input Stage (J11) to Main Tuning Mode Switch (J14)		Sierra	B02051902	1
	CABLE ASSEMBLY, B-Filter (J12) to Main Tuning Mode Switch (J16)		Sierra	B02051903	1
	CABLE ASSEMBLY, B-Filter (J13) to Main Tuning Mode Switch (J15)		Sierra	B02051903	1
	CABLE ASSEMBLY, 2nd L.F. Amplifier (J18) to Feedthru C3 (J31)		Sierra	B02052001	1
	CABLE ASSEMBLY, 2nd Oscillator (J20) to 2nd Modulator (J21)		Sierra	B02084502	1
	CABLE ASSEMBLY, Narrow Band Followers (J24) to Output Amplifier		Sierra	B02084401	1
	CABLE ASSEMBLY, Narrow Band Follower (J25) to Audio		Sierra	B02084400	1
	CABLE ASSEMBLY, I.F. Buffers (J23) to 2nd I.F.		Sierra	B02084402	1
	CABLE ASSEMBLY, AC Switching (J29) to Output Amplifier		Sierra	B02084402	1
	CABLE ASSEMBLY, Input Low-Pass Filter (J32) to Pre-Amplifier		Sierra	B02084402	1

INSTRUCTION MANUAL

BALANCED PROBE
MODEL 128-PA

Stock No. A02512810

May 1969

MODEL 128-PA
BALANCED PROBE

Figure 1. Balanced Probe With Auxiliary Flexible Leads

The Model 128-PA Balanced Probe is an accessory to the Model 128A Frequency Selective Voltmeter with the purpose of providing the Voltmeter with a balanced input.

The Balanced Probe may be used in either the bridging mode or in the terminating mode with the choice of either a 135 ohm or a 600 ohm terminating resistance. A three position slide switch permits the selection of either mode and either of the two terminating resistances. A chart, attached to the probe body for convenient reference, lists the Probe switch settings along with the corresponding Voltmeter input settings. The Probe may also be used on unbalanced circuits, if desired, by grounding either probe tip.

The Probe circuitry is enclosed in a metal and plastic case and is fitted with a 5 foot coaxial cable terminated with a BNC connector for attachment to the 128A Voltmeter. The Probe tips are spaced 1/2 inch apart and are 1-1/2 inches long for convenient manipulation on high component density equipment.

Two sets of flexible extension test leads are furnished to provide maximum auxiliary use of the Probe. The test leads attach to the Probe tips and provide either pin plug or miniature alligator clip termination.

SPECIFICATIONS

CIRCUIT IMPEDANCE	135 Ohms	600 Ohms
FREQUENCY RANGE	10 kc to 3.5 mc	10 kc to 1.5 mc
INSERTION LOSS	20 db ±0.25 db	20 db ±0.25 db
BRIDGING LOSS	0.1 db	0.3 dB up to 620 kc 0.4 dB up to 1.5 mc

INPUT IMPEDANCE	
Bridging Mode	
At 1 mc	13 K in parallel with 18 pf
At 3.5 mc	8 K in parallel with 20 pf
Terminating Mode	
135 Ohm	Reflection coefficient less than 2%
600 Ohm	Reflection coefficient less than 4%
MAXIMUM INPUT LEVEL	+20 dbm
MINIMUM INPUT LEVEL	-90 dbm
DIMENSIONS	
Width	2.2 inches
Thickness	1.3 inches
Length	
Body	4.2 inches
Overall	5.7 inches
Probe Tip Spacing	0.5 inches
Coaxial Cable Length	5 feet
AUXILIARY FLEXIBLE LEADS	
Length	6 inches
2-Red, 1-Brown	Pin jack on one end, pin plug on other
2-Red	Pin jack on one end, miniature alligator clips on other

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
L1	INDUCTOR, Micromin., 1.8 h	909000127	Miller	9230-26	1
P1	PLUG AND CABLE ASSEMBLY			B02045300	1
R1	RESISTOR, Fixed, Metal film, 600 ohm 1% 1/4W	908300001	Campbell	M-07	1
R2	RESISTOR, Fixed, Metal film, 135 ohm 1% 1/4W	908300002	Campbell	M-07	1
R3	RESISTOR, Fixed, Composition, 200 ohm, 5% 1/4W	906900221			
R4	RESISTOR, Variable, Cermet, 200 ohm, 10% 1/8W	907900190	CTS	385PC 201A	1
S1	SWITCH, Slide, DP 3 position, miniature	911000028	Continental Wirt	G-128L	1
T1	TRANSFORMER		Sierra	SS-14782-1	1

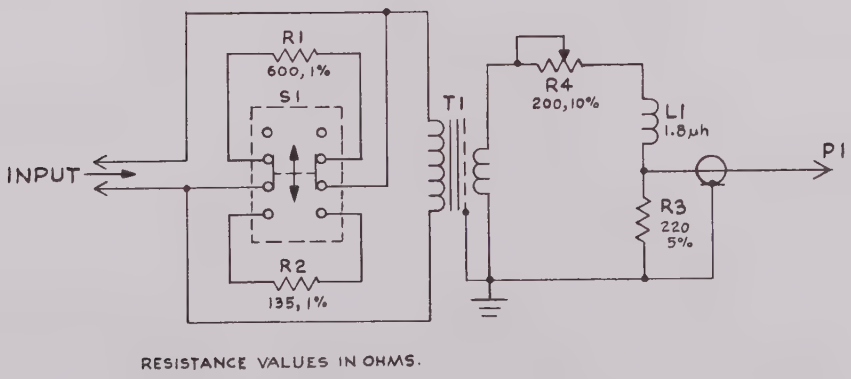


Figure 2. Model 128-PA Balanced Probe Schematic Diagram

INSTRUCTION MANUAL

EXPANDED SCALE METER
MODEL 128-MA

Stock No. A02512820A

May 1969

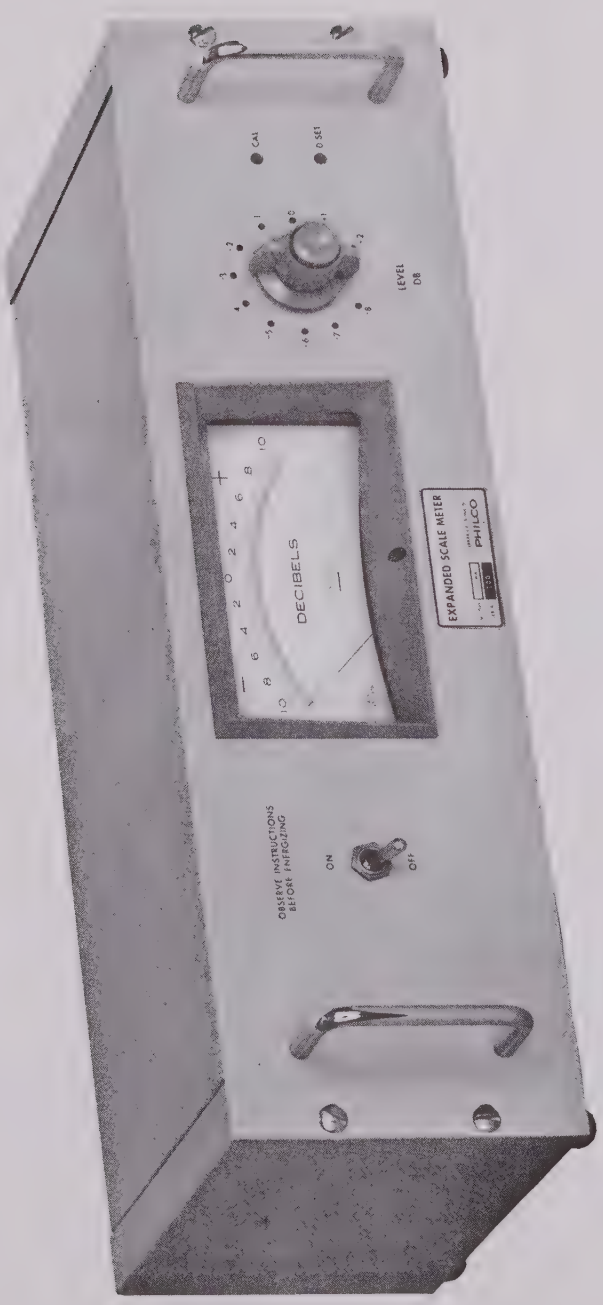


Figure 1-1. Model 128-MA Expanded Scale Meter

SECTION I
GENERAL

A. PURPOSE

The Sierra Model 128-MA Expanded Scale Meter is made for use with Sierra Model 128A Frequency Selective Voltmeter to provide an expanded full scale reading of plus or minus one db readable to 0.01 db. In use the 128-MA is plugged into the Frequency Selective Voltmeter Recorder jack.

B. DESCRIPTION

Major scale divisions of the large, 6 inch, zero db center scale, meter of the 128-MA, are 0.1 db and subdivisions are at 0.02 db intervals so that it is readily possible to read relative level variations as small as 0.01 db. The instrument is equipped with a level control having a range of 10 db in one db steps, so that the Expanded Scale Meter is not limited to one specific two db interval. This makes it possible to use the Expanded Scale Meter at any level between -8 db and +2 db on the Model 128A Voltmeter. Since the 128A can always be made to read in that interval by means of its own 10 db step level control, the Expanded Scale Meter may be used at any level within the range of the 128A Voltmeter. Any tracking error in the 128A is considerably reduced when readings are taken with the 128-MA.

The instrument is mounted on a 5-1/4 inch panel, equal in width to the Model 128A. It can be used either as a rack-mount or as a bench-mount instrument. Sheet metal end pieces equipped with rubber feet fill out both ends for bench use. A 3-3/4 foot length of interconnecting cable allows the 128-MA to be conveniently located a short distance from the 128A Voltmeter

The internal power source is a single cell, size D, zinc-carbon battery. The useable voltage range is between 1.6 and 1.35 volts. The current drain is about 75 microamperes.

The battery should be replaced every six months, or sooner if the voltage drops below the minimum of 1.35 volts.

The 128-MA must be calibrated to the particular Model 128A with which it is to be used. When ordered together the two instruments are calibrated together at the factory. In any case, calibration procedure as given in Section II, A2 should be carried out at regular intervals.

C. SPECIFICATIONS

LEVEL RANGE	+3 db to -9 db, relative to each Model 128A attenuator position
METER	
Range	2 db total
Marking	-1 db to +1 db
Divisions	0.1 main divisions 0.02 subdivisions
Resolution	0.01 db
LEVEL SELECTOR	
Range	10 db
Marking	+2 db to -8 db
Divisions	1 db
IMPEDANCE	1200 ohms
POWER SUPPLY	
Type	Internal Battery 1 size D cell
Current Drain	75 microamperes
LENGTH OF CABLE	3-3/4 feet
CONNECTOR	Telephone plug
MOUNTING	Rack or bench
DIMENSIONS	
Width	19 inches
Height	5-1/2 inches
Depth	7-3/8 inches
Depth (including handles)	9 inches
WEIGHT	9 pounds

SECTION II
OPERATION

Since the 128A is a very sensitive instrument and subject to damage by overload it is important that the following operating instructions be carefully read before energizing the meter.

A. PRELIMINARY CHECKS AND CALIBRATION

The power switch should be left in the OFF position, except when readings are to be made.

1. Polarity

When connecting the 128-MA to a Model 128A Frequency Selective Voltmeter with which it has not previously been used, the RECORDER jack polarity should be checked as follows:

a. Plug the 128-MA into the 128A Voltmeter RECORDER jack. (128-MA power switch OFF.)

b. Turn the 128A Voltmeter Attenuator switch to CAL and adjust for a 128A meter reading of about 0 db.

c. Unscrew the plastic handle of the 128-MA interconnecting cable plug, leave plug in position in the RECORDER jack and check relative polarity of terminals. The white wire, plug sleeve connection, should be positive with regard to the black wire, plug tip connection.

2. Calibration

The Model 128-MA Expanded Scale Meter (ESM) must be calibrated to the 128A Frequency Selective Voltmeter (FSVM) with which it is to be used. Calibration procedure should be carried out at regular intervals.

a. Equipment Required (Instruments listed or their equivalent)

Multimeter	Simpson 260
DC Voltmeter	HP 413
Signal Generator	HP 606A
600 Ohm Attenuator	Daven VT-795-G

Test Fixture	1.5V zinc-carbon battery with 60K resistor (two 120K resistors in parallel)soldered to it.
Resistor	560 ohm, 5%, 1/4W
Clip Leads (2)	

Sierra Model 128A Frequency Selective Voltmeter to which Model 128-MA is to be calibrated.

CAUTION: The 128-MA power switch must be kept in the OFF position at all times unless specifically instructed otherwise.

b. Resistance Check (All except step (3) should be omitted when routine calibration is performed)

(1) Adjust R21-R30 and R39 exclusing R22 to midrange (7-1/2 turns from either end)

(2) Turn CAL control on front panel of the 128-MA six full turns clockwise from end point.

(3) Check the resistance between the tip and the sleeve of the 128-MA plug with an ohmmeter for all positions of the LEVEL attenuator of the 128-MA. The resistance must be exactly the same for all positions of the LEVEL attenuator control. (Resistance value may be anywhere between 1000 and 1200 ohm. The important thing is that the resistance be exactly the same for each setting of the LEVEL attenuator control.) If resistance is different in one or more positions, return to factory for repair.

c. Meter Bridge Balance

(1) Set the 128-MA LEVEL control to -8 db. Remove internal battery from the 128-MA and connect Test Fixture (1.5V battery in series with 60K resistor) in its place, but with reverse polarity. Use the two clip leads.

(2) Switch the 128-MA to ON. This will bring the meter slowly to about full scale.

(3) Set the HP 413 to its most sensitive range in EXPANDED position. Short leads and zero meter.

(4) Connect the HP 413 to test points TP1 and TP2. See Figure 3-1.

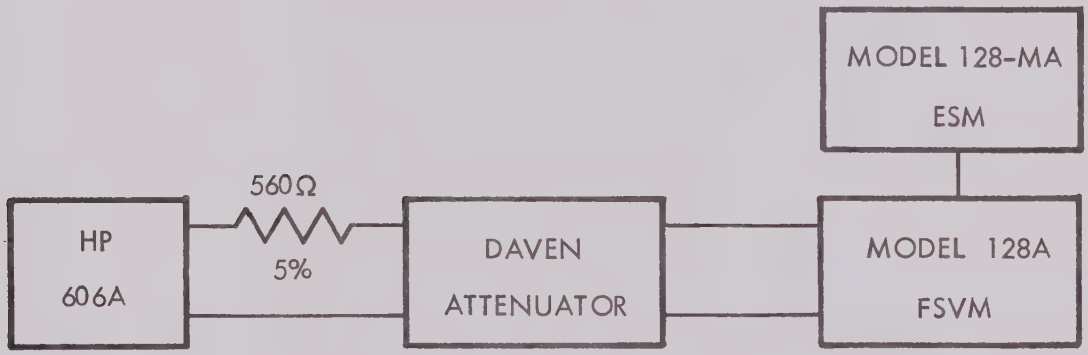
(5) Adjust potentiometer R36 for zero reading on the HP 413.

(6) Turn the switch on the 128-MA to OFF. Remove test Fixture and replace the internal battery.

NOTE: Once the above adjustment is made either at the factory or in the meter calibration shop, it should only need checking at infrequent intervals.

d. Calibration Procedure

(1) Test Setup



(2) Allow at least one hour for warmup of equipment then set the HP 606A to 100 kc and output level to about 0 dbm. Set Daven attenuator to 22.0 db. Set the 128A FSVM to -20 db, TERM, 600 Ohms. Adjust the level of the HP 606A so that the 128A reads close to 0 db.

(3) Plug the 128-MA into the 128A, then set the 128A to read exactly 0 db using the CAL control.

(4) Set the 128-MA LEVEL control to 0 db, turn the switch to ON and adjust to read zero by adjusting the 0-SET control on the front panel.

(5) Remove 1 db of attenuation (switch the Daven attenuator from 2 db to 1 db) and note position at which 128-MA meter needle comes to rest.

(6) Add 1 db of attenuation to the circuit (reset Daven attenuator from 1 db to 2 db), then adjust CAL control as follows: If meter came to rest short of +1 db in the preceding step turn CAL control clockwise until meter moves about five times as much as it was short of +1 db. Turn CAL counterclockwise if needle of meter was above +1 db.

(7) Very accurately reset meter to 0 db with the 0-SET control. Check that 128A is exactly on 0 db when making this setting.

(8) Repeat steps (5), (6) and (7) as necessary until the 128-MA accurately covers the 0 to 1 db range when 1 db is removed from the attenuator. When this adjustment has been accurately made, do not again change the 0-SET or CAL adjustments for remainder of calibration procedure.

(9) With the 128A and the 128-MA exactly set to 0 db, increase the attenuation 1 db (set Daven to 3 db). 128-MA should read -1 db ±0.02 db.

(10) Reset the Daven attenuator to 2 db. Then turn the 128-MA LEVEL control to -1 db and the Daven attenuator to 3 db, both at the same time. When the 128-MA meter has come to rest, adjust R23 for a reading of exactly 0 db.

(11) Set the 128-MA LEVEL control to -2 db and the Daven attenuator to 4 db at the same time. When the meter has come to rest adjust R24 for a reading of exactly 0 db. In the same manner take the 128-MA and the Daven attenuator down in 1 db steps to -8 db on the 128-MA, adjusting resistors R25-R30 for 0 db reading. Check that the 128A remains at exactly 0 db at each step. Use 128A CAL control to adjust if necessary.

(12) Return the 128-MA to 0 db and the Daven attenuator to 2 db. Switch both controls at the same time. Then switch the 128-MA LEVEL control to +1 db and the Daven attenuator to 1 db. Adjust R21 for a 0 db reading on the 128-MA. Follow same procedure for +2 db, adjusting R39.

(13) Turn 128-MA power switch to OFF before unplugging from the 128A.

NOTE: The following Speed-Up technique may be used: Whenever the 128-MA reading is to be changed 1 db, the movement of the meter may be speeded up by setting the LEVEL control 1 db farther than required and watching meter needle movement. When needle approaches the expected point, switch the LEVEL control rapidly back to the proper position.

(14) After the calibration adjustment is completed the 0-SET control may be adjusted without affecting the calibration. Due to aging of the battery it will be necessary, occasionally, to readjust the 0-SET, steps d2 through d4. This will not affect the calibration.

NOTE: For 128-MA 0-SET adjustment only the 128A Gain Reference Oscillator (128A attenuator switch in CAL position) may be used to set the 128A meter to exactly 0 db in place of an external signal generator.

It may be noticed that after the 128-MA is calibrated as above, if the signal is reduced to -8 db on the 128A meter (signal level change on the 128A followed by switching the 128-MA LEVEL control down to -8 db as the signal level is lowered) that the -8 db signal level on the 128A meter does not exactly correspond to 0 db on the 128-MA meter. The extreme of variation should be less than .3 db. This is due to the allowable tracking error of the 128A meter scale. In this case the 0 db setting of the 128-MA will accurately represent -8 db. Points between -8 db and -2 db will show a relatively smaller tracking error. The +2 db point should be almost exact.

B. OPERATIONAL PROCEDURE

The power switch should be kept in the OFF position except when readings are to be made.

Assuming that the 128-MA has been properly calibrated with the 128A Voltmeter with which it is to be used, is plugged into the 128A and the power switch is OFF, follow the procedure given below:

1. Tune the 128A Voltmeter to the desired signal and set the Input Attenuator so that the meter reads between -8 db and +2 db.

2. Set the LEVEL control of the 128-MA to the position that is closest to the 128A meter reading. For example: A signal reads between -3 db and -2 db, but is closest to -2 db on the 128A meter. Set the 128-MA LEVEL control to -2 db. Zero db on the 128-MA now corresponds to -2 db, and the 128-MA meter covers the range of -3 db to -1 db.

3. Switch the 128-MA to ON and take reading.

4. The meter of the 128-MA may be kept on-scale with large excursions of signal level in the 128A, within the 10 db range of the 128-MA LEVEL control, by following the 128A meter reading in db with the LEVEL control of the 128-MA.

5. When a change in level beyond the range of the 128-MA level control is to be made:

   a. Turn the 128-MA power switch to OFF.

   b. Make readjustment for signal with the 128A Attenuator until the 128A meter reads between -8 db and +2 db.

   c. Set the 128-MA LEVEL control to the position that is closest to the 128A meter reading (see paragraph 2. above).

d. Turn 128-MA power switch to ON and make reading.

6. Check the zero setting of the 128-MA occasionally, paragraph A.2. d2 through d4 to correct for battery aging.

Always turn the 128-MA power switch to OFF before unplugging from the 128A.

The signal input to the 128A Voltmeter should never be interrupted, or abruptly changed in level as long as the 128-MA is plugged into the 128A and is turned ON. Switch OFF the 128-MA before such changes are made.

Switching OFF the 128-MA will not change the meter reading of the 128A Voltmeter as long as the 128-MA is left plugged in, so the Voltmeter may be used in the normal manner without unplugging the 128-MA.

C. OVERLOAD CONSIDERATIONS

The 128-MA Expanded Scale Meter is designed to take from 5 to 10 times overload without damage.

If the meter is switched on without being plugged into the 128A, or if the signal being measured is switched off while the 128-MA is plugged in and operating, the meter pointer will be deflected violently to the left by the battery "bucking" voltage. This is an overload of approximately 3.6 times and should not damage the meter coil, although the pointer may eventually become bent.

If the signal level is increased 10 db by switching the 128A Voltmeter Attenuator of the signal generator level, without turning OFF the 128-MA, the meter will be overloaded about ten times and quite possible may be camaged.

If the signal level is increased 20 db by switching either the 128A Voltmeter attenuator or the signal generator level without turning OFF the 128-MA, meter damage is likely to occur.

Habitual care in adjusting signal levels to be measured and the practice of keeping the 128-MA switch OFF except when making readings, can prevent serious overloading of the instrument.

SECTION III
THEORY OF OPERATION

The 128-MA Expanded Scale Meter is built around a balanced bridge circuit. The arms of the bridge are R31, R32, R33 and the Meter M1, with its calibrating resistor R36. (Refer to the Schematic Diagram)

Current from the 128A Voltmeter is applied between points A and B (see schematic) and the meter "bucking" current is applied between points P and Q.

Resistors R1 through R10 are the multiplier resistors in parallel with points A and B. Resistors R11 through R20 are the impedance balancing resistors in series with the bridge points A and B. These resistors are selected by the LEVEL switch S1A and S1C.

The meter "bucking" battery is connected between points P and Q in series with the current limiting and calibrating resistors R35 and R37. This "bucking" current connection to the balanced bridge circuit prevents the battery current from flowing in the 128A output circuit. Also connected between P and Q are the resistors R21 through R30 and R39, selected by LEVEL switch S1E. These resistors provide a fine adjustment for the "bucking" current through the meter for every setting of the LEVEL control to provide improved linearity.

The purpose of the "bucking" current is to make it possible to measure the difference between two fairly large currents with a very sensitive meter. The difference at the zero db point on the meter is 5 microamperes and a difference of 0 to 10 microamperes covers a two db range, although the currents actually flowing from the battery and the 128A are much larger. Since the bucking current remains constant, the meter responds to any change in current from the 128A and is calibrated to show this change in db.

When the 128-MA power switch is turned to the OFF position the meter is switched out of the circuit and a resistance equal to the meter internal resistance is switched in. Thus the 128A sees exactly the same resistance whether the 128-MA is ON or OFF as long as it is left plugged into the 128A. In addition, in the OFF position, the switch puts a shunt across the meter and disconnects the internal battery.

R38 is the front panel CAL adjustment and R37 is the 0-SET adjustment. R36 is an internal, factory set adjustment to compensate for slight differences in meter internal resistances.

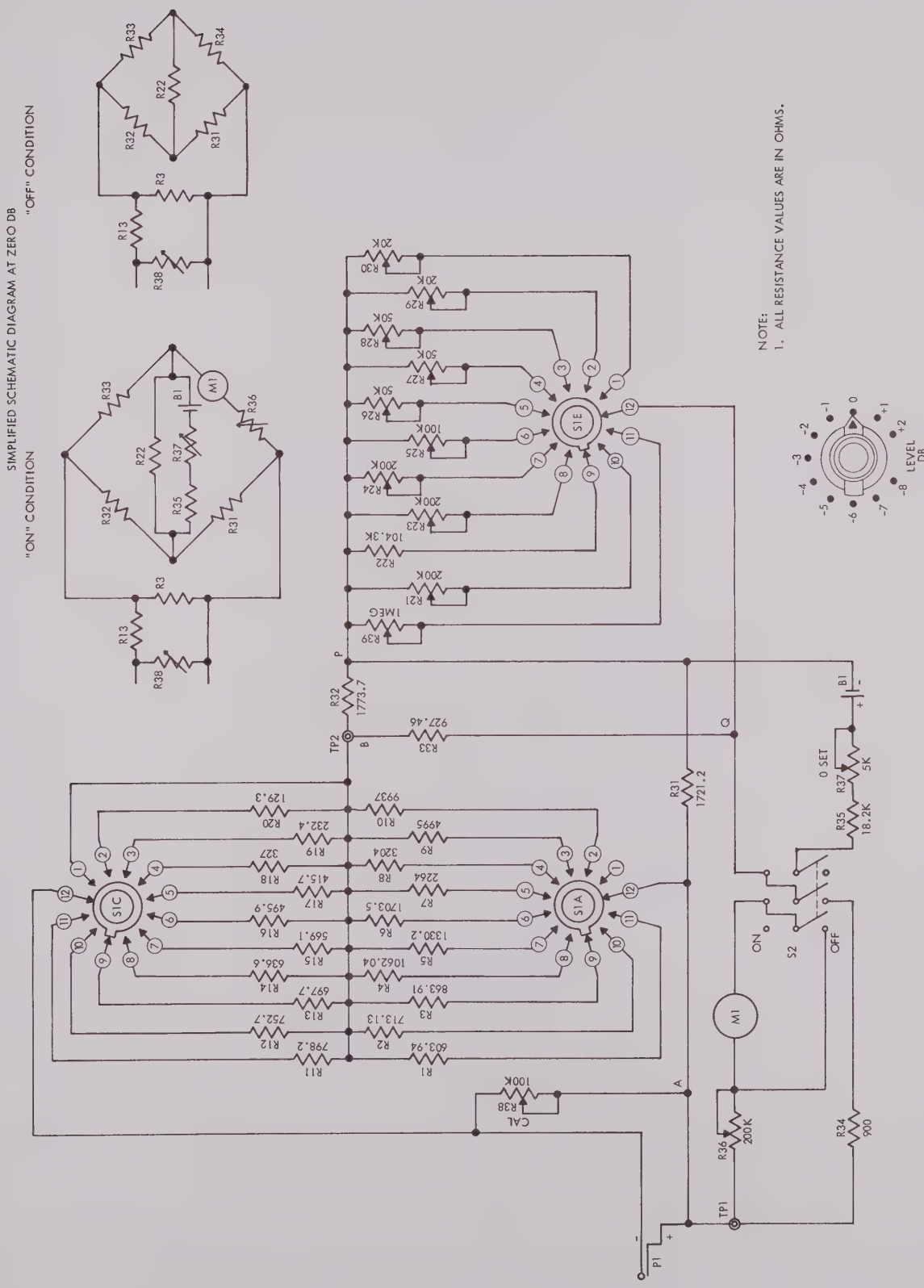


Figure 3-1. Model 128-MA Expanded Scale Meter Schematic Diagram

SECTION IV
REPLACEABLE PARTS LIST

PARTS REPLACEMENT

Standard components have been used in this instrument whenever possible. Both standard and special components may be ordered direct from the factory.

When ordering parts always include:

1. Sierra Stock Number.
2. Circuit Reference and Commercial Description.
3. Name, Model and Serial Number of the Instrument.

Parts for this instrument, or further service information may be obtained from:

SIERRA ELECTRONIC OPERATION
Philco-Ford Corporation
3885 Bohannon Drive
Menlo Park, California 94025

Telephone (415) 322-7222
TWX 910-373-1282

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
B1	BATTERY, D-Cell, Zinc-Carbon	918500006	Mallory		1
M1	METER, Taut Band, 10 microamp	911800082	A.P.I. 1602	A02024700	1
P1	PLUG-CORD Assembly		Sierra	B02034200	1
R1	RESISTOR, 603.94Ω Fixed WW, 0.05% 1/4W	906100034	Vidar	255A	1
R2	RESISTOR, 713.13Ω Fixed WW, 0.05% 1/4W	906100035	Vidar	255A	1
R3	RESISTOR, 863.91Ω Fixed WW, 0.05% 1/4W	906100036	Vidar	255A	1
R4	RESISTOR, 1062.04Ω Fixed WW, 0.05% 1/4W	906100037	Vidar	255A	1
R5	RESISTOR, 1330.2Ω Fixed WW, 0.05% 1/4W	906100038	Vidar	255A	1
R6	RESISTOR, 1703.5Ω Fixed WW, 0.05% 1/4W	906100039	Vidar	255A	1
R7	RESISTOR, 2264.0Ω Fixed WW, 0.05% 1/4W	906100040	Vidar	255A	1
R8	RESISTOR, 3204Ω Fixed WW, 0.1% 1/4W	906100041	Vidar	255A	1
R9	RESISTOR, 4995Ω Fixed WW, 0.1% 1/4W	906100042	Vidar	255A	1
R10	RESISTOR, 9937Ω Fixed WW, 0.2% 1/4W	906100043	Vidar	255A	1
R11	RESISTOR, 798.2Ω Fixed WW, 0.2% 1/4W	906100044	Vidar	255A	1
R12	RESISTOR, 752.7Ω Fixed WW, 0.2% 1/4W	906100045	Vidar	255A	1
R13	RESISTOR, 697.7Ω Fixed WW, 0.2% 1/4W	906100046	Vidar	255A	1
R14	RESISTOR, 636.6Ω Fixed WW, 0.2% 1/4W	906100047	Vidar	255A	1
R15	RESISTOR, 569.1Ω Fixed WW, 0.2% 1/4W	906100048	Vidar	255A	1
R16	RESISTOR, 495.9Ω Fixed WW, 0.2% 1/4W	906100049	Vidar	255A	1
R17	RESISTOR, 415.7Ω Fixed WW, 0.2% 1/4W	906100050	Vidar	255A	1
R18	RESISTOR, 327.0Ω Fixed WW, 0.5% 1/4W	906100051	Vidar	255A	1
R19	RESISTOR, 232.4Ω Fixed WW, 0.5% 1/4W	906100052	Vidar	255A	1
R20	RESISTOR, 129.3Ω Fixed WW, 1.0% 1/4W	906100053	Vidar	255A	1
R21	RESISTOR, 200K, Variable, ±20%, .2W, 15 Turn	907900202	Bourns	3068P-1-204	3
R22	RESISTOR, 104.3K Fixed WW, 1.0% 1/4W	906100055	Vidar	255A	1
R23	Same as R21				
R24	Same as R21				
R25	RESISTOR, 100K, Variable, ±20%, .2W, 15 Turn	907900203	Bourns	3068P-1-104	1
R26	RESISTOR, 50K, Variable, ±20%, .2W, 15 Turn	907900204	Bourns	3068P-1-503	3
R27	Same as R26				
R28	Same as R26				
R29	RESISTOR, 20K, Variable, ±10%, .5W, 15 Turn	907900205	Bourns	3067P-1-203	2
R30	Same as R29				
R31	RESISTOR, 1721.2Ω Fixed WW, 0.05% 1/4W	906100064	Vidar	255A	1
R32	RESISTOR, 1773.7Ω Fixed WW, 0.05% 1/4W	906100065	Vidar	255A	1
R33	RESISTOR, 927.46Ω Fixed WW, 0.05% 1/4W	906100066	Vidar	255A	1
R34	RESISTOR, 900.00Ω Fixed WW, 0.05% 1/4W	906100067	Vidar	255A	1
R35	RESISTOR, 18.2K Fixed WW, 1.0% 1/4W	906100068	Vidar	255A	1
R36	RESISTOR, 200Ω Variable, 1W, 10%	907900192	Spectrol	74-2-1-201	1
R37	RESISTOR, 5KΩ Variable, 1W, 10%	907900193	Spectrol	74-2-1-502	1
R38	RESISTOR, 100KΩ Variable, 1W, 10%	907900194	Spectrol	74-2-1-104	1
R39	RESISTOR, 1 Meg, Variable, ±20%, .2W, 15 Turns	907900206	Bourns	3068P-1-105	1
S1	SWITCH, Rotary	911200109	Centralab	A02039000	1
S2	SWITCH, Toggle	911000029	A H & H		1

INSTRUCTION MANUAL

UNIVERSAL SPEAKER KIT

A02509900A

MAY 1969

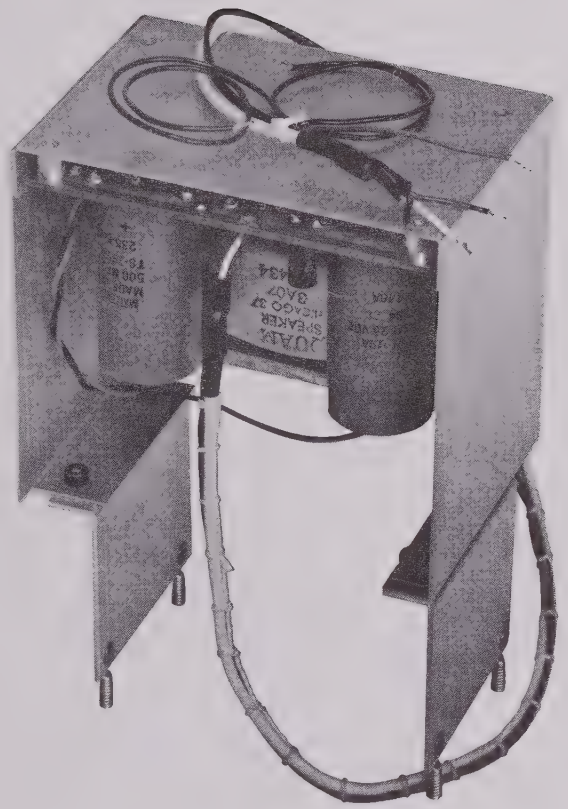


Figure 1. Speaker Assembly with Model 125/126 Brackets

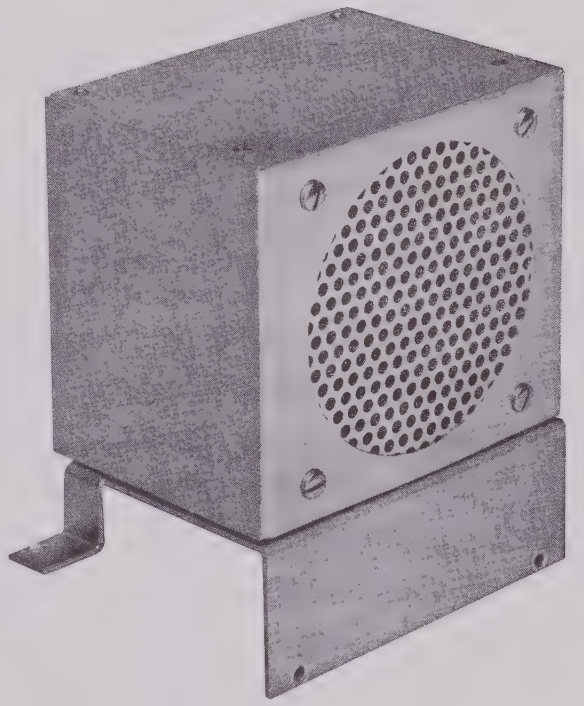


Figure 2. Speaker Assembly with Model 128 Brackets

UNIVERSAL SPEAKER KIT

DESCRIPTION

The Sierra Universal Speaker Kit is made for use with all series and versions of the Sierra Models 125, 126 and 128 Frequency Selective Voltmeters. Installation of the Kit provides loud speaker monitoring of the audio modulation on the carrier signal being measured.

The Kit is made up of an audio amplifier and speaker mounted in a speaker case, a connecting cable and panel jack, and the required mounting brackets and hardware.

The three transistor amplifier, consisting of a driver stage and push-pull output stage, furnishes sufficient power to provide adequate speaker volume. Output level to either the speaker or headphones is controlled by the Voltmeter Audio Gain control. Power for the amplifier is taken from the Voltmeter, either through a dropping resistor from the power supply of the Model 128, or through a voltage doubling rectifier from the filament supply of the Model 125 or 126. The rectifier and dropping resistor are mounted on the speaker audio circuit board. The jack furnished with the kit, when installed to replace the Phones jack originally in the Voltmeter, switches off the speaker whenever headphones are plugged into the Voltmeter Phones jack.

SPECIFICATIONS

FREQUENCY RANGE	300 cps to 5 kc
Installed In Voltmeter	300 cps to 2.5 kc
FREQUENCY RESPONSE	±1 db
INPUT	2 volts p-p maximum
OUTPUT	0.25 watts undistorted
POWER REQUIREMENTS	
From Models 125, 126	6.3 volts AC, 120 ma, 50-1000 cps
From Model 128	-24 volts DC, 45 ma

SPECIFICATIONS (continued)

DIMENSIONS (without brackets)	
Height	3-5/8 inches
Width	4 inches
Depth	2-7/8 inches
WEIGHT (without brackets)	14 ounces
SIERRA PART NO.	B02074000

INSTALLATION PROCEDURE

1. Solder VIOLET wire to proper terminal on Speaker Kit circuit board.

   For Models 125 and 126 - to terminal marked 6.3 vac.(Figure 5).
   For Model 128 - to terminal marked -24 vdc. (Figure 6).

2. Drill holes in chassis as required:

   For Models 125 and 126, see Figure 3.
   For Model 128, see Figure 4.

   Later production runs of all models will have the holes pre-punched in the chassis.

3. Select brackets required and attach to speaker case:

   For Models 125 and 126, see Figure 1.
   For Model 128, see Figure 2.

4. Fasten speaker case to chassis by means of brackets.

   For Models 125 and 126, use number 6 Kep nuts on spade lugs.
   For Model 128, use number 4 machine screws and Kep nuts.

   (In the -Y version of the Model 125, the "existing holes", Figure 3, are used to attach an under-chassis shield bracket. The screws in these holes are to be removed. The spade lugs on the speaker brackets replace them to hold both the speaker case and the under-chassis shield bracket.)

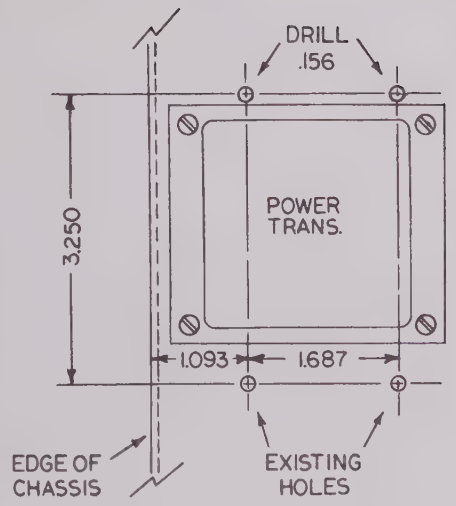


Figure 3. Mounting Hole Location Model 125/126

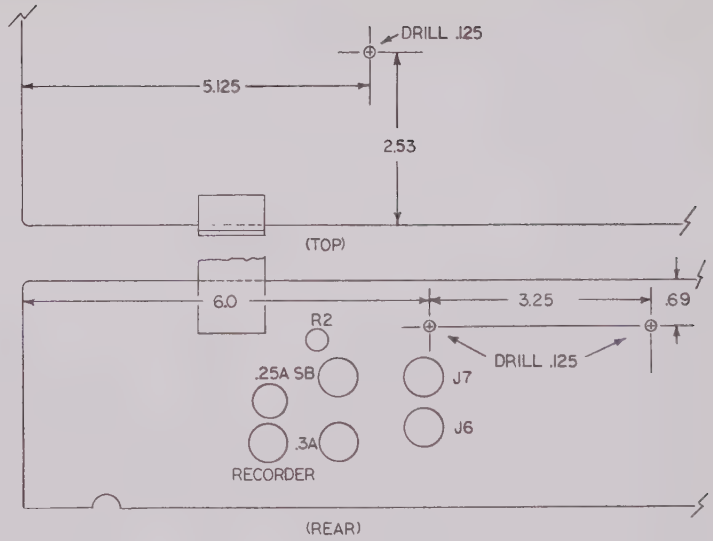


Figure 4. Mounting Hole Location Model 128

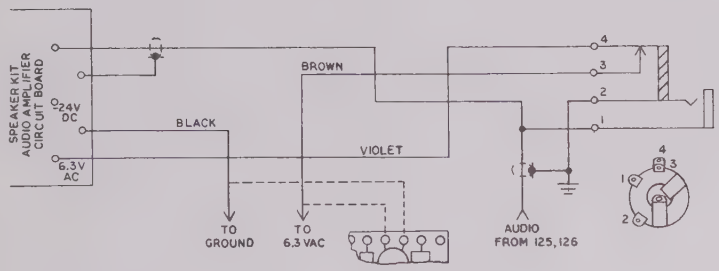


Figure 5. Wiring Diagram Model 125/126

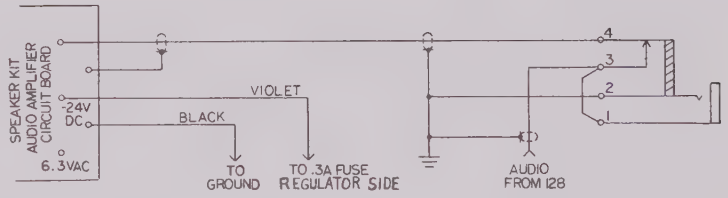


Figure 6. Wiring Diagram Model 128

5. Run Speaker Kit cable into bottom of chassis.

In Models 125 and 126, lay cable in front of Mixer module cover and run down through space between RF tuning casting and chassis. Secure cable to projecting meter stud with plastic cable clamp and 6-32 Kep nut.

In Model 128, run cable down through large rubber grommet near center of chassis.

6. Disconnect leads from PHONES jack. Remove old jack and install the jack supplied with the kit. (Later production runs of all models will contain the new type jack as standard equipment.)

7. Reconnect audio leads and connect free end of speaker cable to jack according to wiring diagram. Connect Brown and Black leads to circuit board.

For Models 125 and 126 use Figure 5. Lead length is such that wiring runs are direct.

For Model 128 use Figure 6 and following procedure:

a. Remove shield cover from Audio circuit board of the 128 Voltmeter.

b. Pull the Violet and Black wires out of the cable tie near the free end.

c. Connect the Audio lead from the Model 128 Audio circuit board to jack terminal 1.

d. Run the Audio lead of the speaker cable underneath the Model 128 Audio circuit board and connect to jack terminal 4. Connect shield and ground lead from Audio circuit board to jack terminal 2.

e. Cut off the long free end of the Brown wire. Leave enough to make the jumper connection from terminal 1 to 3 on the jack, as indicated in Figure 6.

f. Cut the Black lead to a convenient length and connect to one of the ground lugs near the power supply circuit board.

g. Connect the free end of the Violet wire to the regulator side of the .3A fuse.

h. Replace cover over Audio circuit board.

UNIVERSAL SPEAKER KIT

LIST OF PARTS IN KIT

1 - Speaker assembly, with speaker and printed circuit board amplifier mounted in the case, and the interconnecting cable attached to the circuit board, except for the Violet wire.

1 - Single circuit jack, with switching contacts.

2 - Speaker mounting brackets with spade lugs attached. (For Models 125 and 126)

1 - Speaker mounting bracket for Model 128.

5 - 6-32 Kep nuts.

7 - 4-40 x 5/16 BHNP machine screws.

3 - 4-40 Kep nuts.

1 - 3/16" plastic cable clamp.

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
C1	CAPACITOR, 1 µf, 25V	903300105			1
C2	CAPACITOR, 500 µf, 25V	902210507	Mallory	PTC	2
C3	Same as C2				
C4	CAPACITOR, 22 mf, 25V	903300226			1
CR1	DIODE	910500031		1N456	1
CR2	DIODE	910800008		DI 56	2
CR3	Same as CR2				
J1	CONNECTOR, Phone	914400014	Switchcraft	Littel Jak #13E	1
LS1	LOUDSPEAKER	921400002	Quam	3A07	1
Q1	TRANSISTOR, PNP	910300007	G.E.	2N404	1
Q2	TRANSISTOR, NPN	910300033	G.E.	7A31	2
R1	RESISTOR, 33K Ohm ±5% 1/4W	906900333	A.B.	CB	1
R2	RESISTOR, 10K Ohm ±5% 1/4W	906900103	A.B.	CB	1
R3	RESISTOR, 2.2K Ohm ±5% 1/4W	906900222	A.B.	CB	1
R4	RESISTOR, 22K Ohm ±5% 1/4W	906900223	A.B.	CB	2
R5	Same as R4				
R6	RESISTOR, 4.7 Ohm ±10% 1/4W	907100470	A.B.	CB	2
R7	Same as R6				
R8	RESISTOR, 180 Ohm ±5% 1/2W	905000181	A.B.	EB	1
R9	RESISTOR, 3.3K ±5% 1/4W	906900332	A.B.	CB	1
T1	TRANSFORMER, Transistor P-P Input	910000072	UTC	SSO-8	1
T2	TRANSFORMER, Transistor P-P Output	910000074	UTC	0-22	1
	CABLE CLAMP	915300010			1

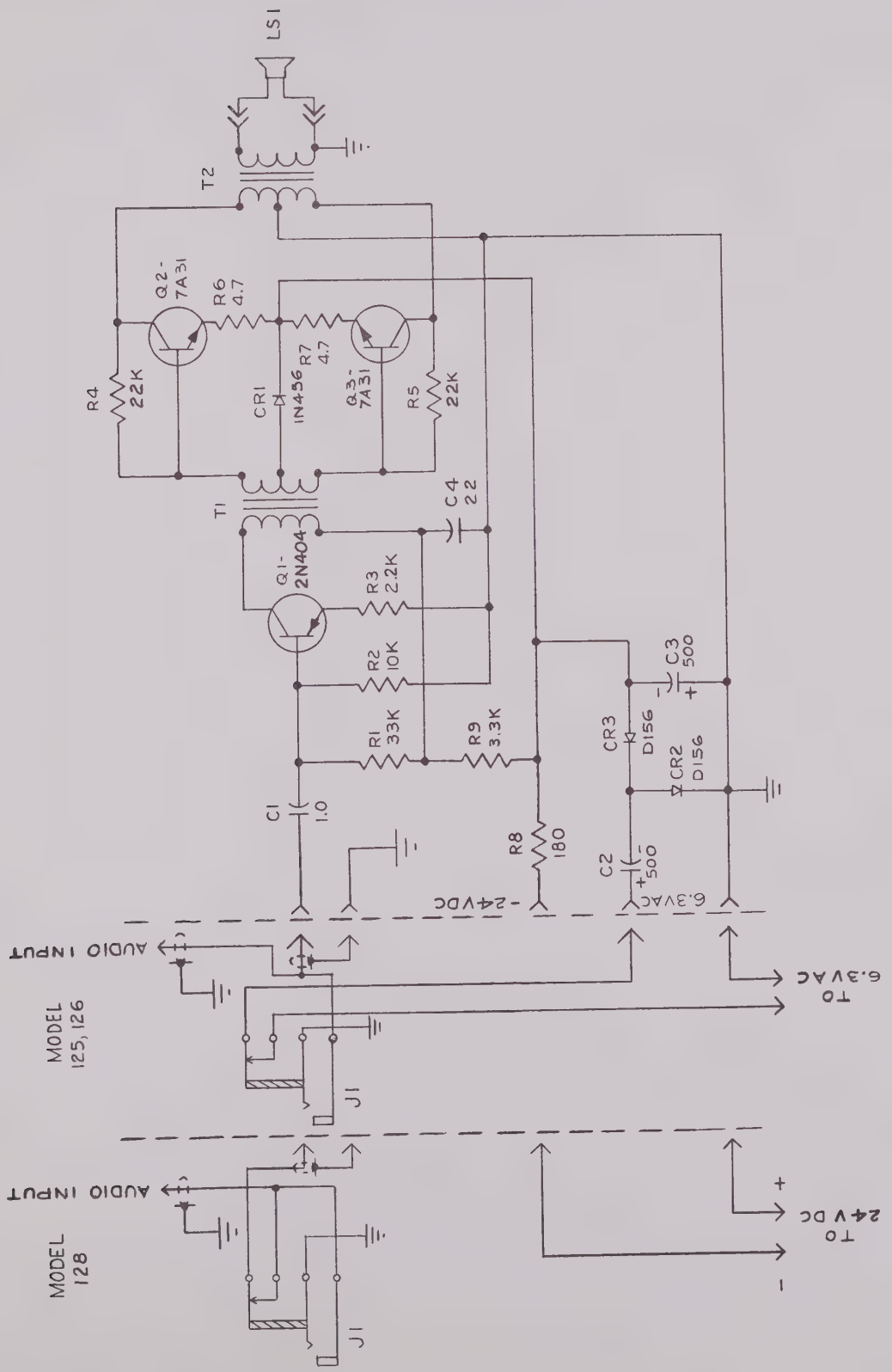


Figure 7. Universal Speaker Kit Schematic Diagram

MODEL 220A-1

EQUIPMENT CONSOLE

MODEL 220A-1

EQUIPMENT CONSOLE

The Model 220A-1 Equipment Console is available as an accessory to the Model 128A, Frequency Selective Voltmeter. This unit provides for mounting of the Model 128A plus up to five accessories or accessory equipments and a front panel mounted speaker.

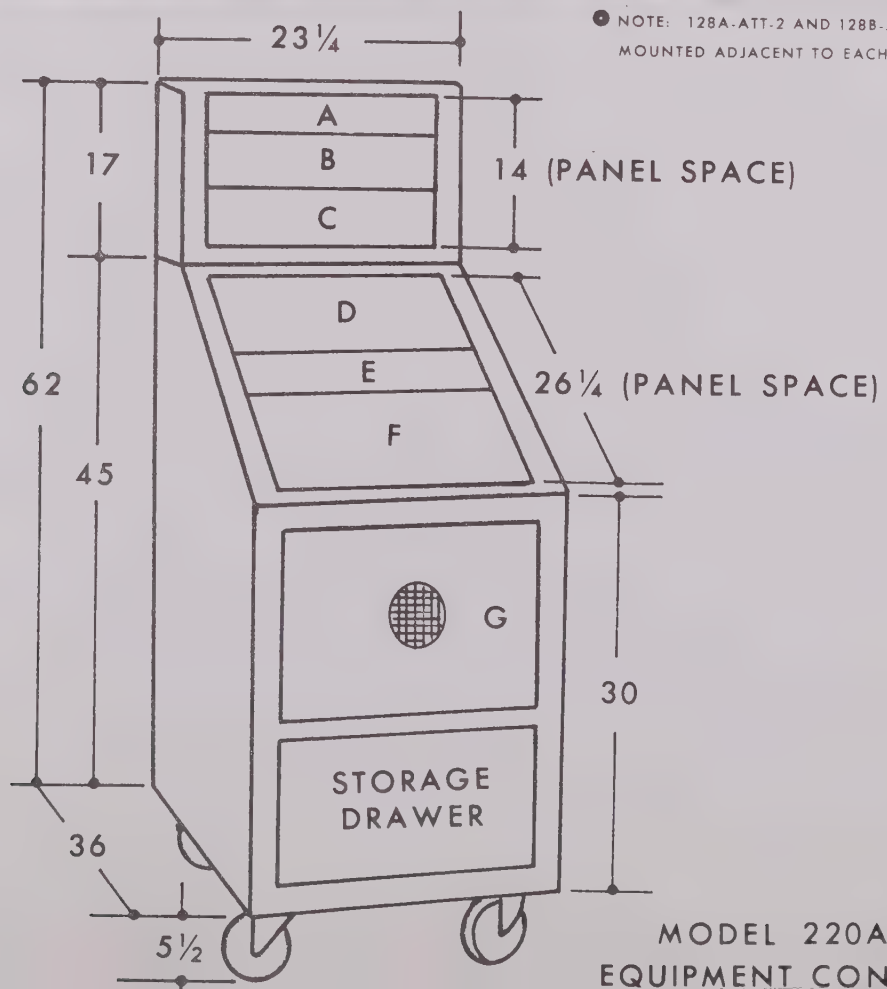
The Equipment Console has an overall height of 67-1/2 inches including casters, a width of 23-1/4 inches, and a maximum depth of 36 inches. The unit is caster mounted for easy movement, with a storage drawer provided for storing probes, connectors, and cables. An outline drawing of the Equipment Console is shown on the following page with other dimensions shown for the console.

Each panel mounting location on the Equipment Console is identified by a letter which in turn is cross-referenced in the Equipment Options table to the various equipments which may be located in the particular panel mounting location.

EQUIPMENT OPTIONS

SPACE	OPTION 1	OPTION 2	OPTION 3
A	BLANK 3½ C02783502	BLANK 5¼ C02783503	128A-ATT-2 ⊙ 3½
B	BLANK 5¼ C02783503	128A-ATT-2 ⊙ 3½	128B-JP ⊙ 5¼
C	BLANK 5¼ C02783503	128B-JP ⊙ 5¼	128-MA 5¼
D	BLANK 10½ C02783506	351A 10½	351A 10½
E	BLANK 5¼ C02783503	128-MA 5¼	360A 5¼
F	128A 10½	128A 10½	128A 10½
G	PANEL WITHOUT SPEAKER C02779300	PANEL WITH SPEAKER C02770800	

⊙ NOTE: 128A-ATT-2 AND 128B-JP MUST BE MOUNTED ADJACENT TO EACH OTHER



MODEL 220A-1
EQUIPMENT CONSOLE

PHILCO-FORD CORPORATION
Sierra Electronic Operation
Menlo Park, California • 94025

TELEPHONE (415) 322-7222 TWX 910-373-1282

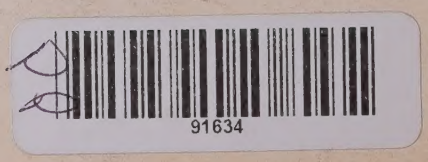
Warranty

SIERRA ELECTRONIC OPERATION, PHILCO-FORD CORPORATION warrants instruments manufactured by it and bearing Sierra commercial model numbers, except Infrared Cells, to be free from defective material and factory workmanship and agrees to repair such instruments, which under normal use and service, disclose the defects to be the fault of our manufacturing. Our obligation under this warranty is limited to repairing any such instrument which in our sole opinion upon our examination proves to be so defective, when returned to our factory at 3885 Bohannon Drive, Menlo Park, California 94025, transportation prepaid by the purchaser, within one year from the date of original purchase from us.

This warranty does not apply to any products which have been repaired, worked upon or altered by persons not authorized by us so as, in our sole judgement, to injure the stability or reliability of such instrument, or which have been subject to misuse, negligence or accident, or the serial number of which has been altered, effaced, or removed. Neither does this warranty apply to any of our products which have been connected, installed, used or adjusted otherwise than in accordance with the instructions furnished by us. Nor does SIERRA assume any liability for consequential damages, and in any event our liability shall in no case exceed the original purchase price of the instrument. Accessories, including but not limited to all vacuum tubes, fuses and batteries, not of our manufacture used with this product are not covered by this warranty.

SIERRA reserves the right to make changes in the design or construction of any of its instruments at any time without incurring any obligation to make any changes whatever on units previously purchased.

This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to represent nor assume for us any liability in connection with the sale of our products other than set forth herein. In no event will seller be liable for any incidental or consequential damages.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